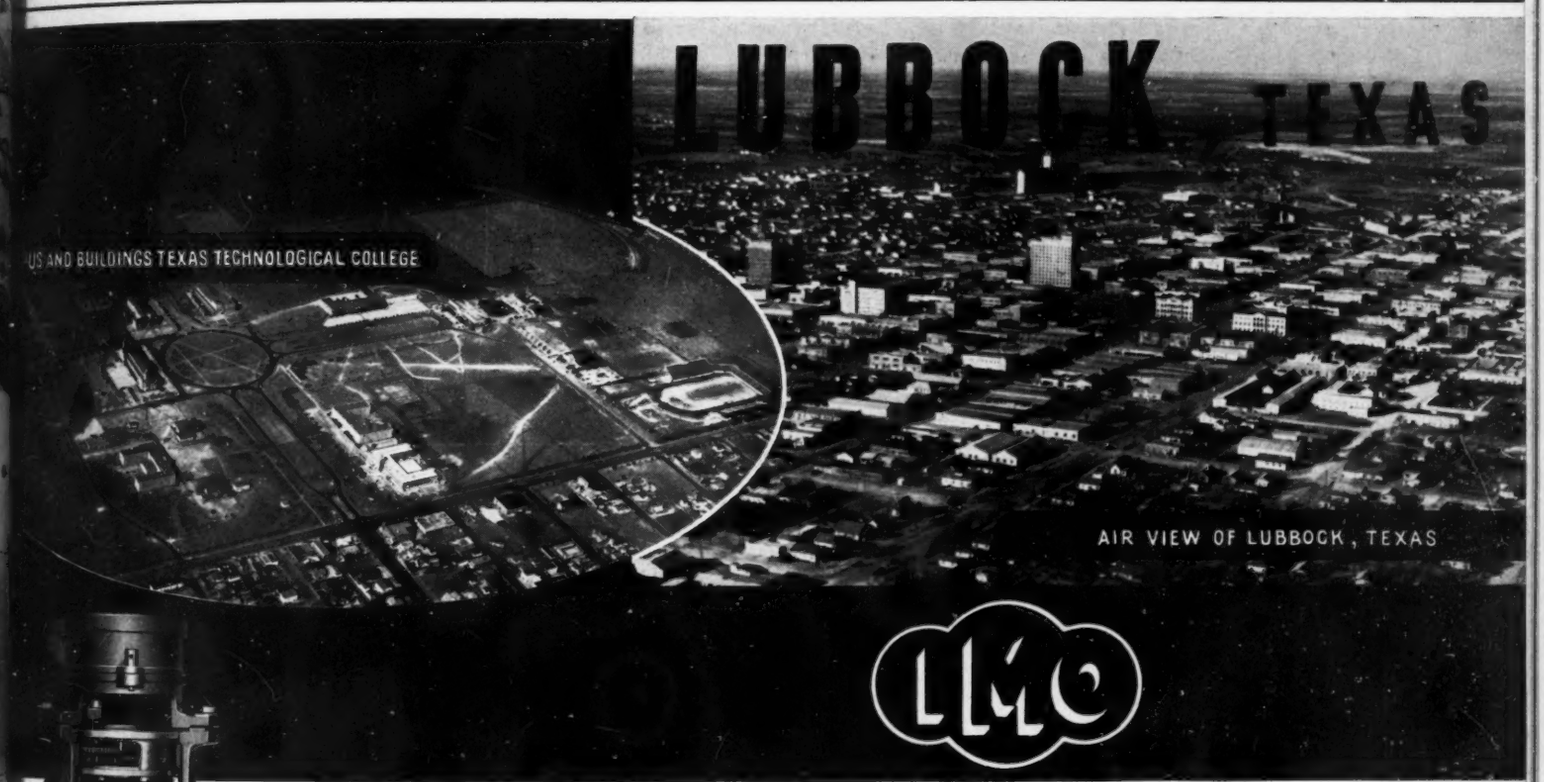
WATER WORKS & SEWERAGE

A GILLETTE ABP ABC PUBLICATION

Vol. 86, No. 8 AUGUST, 1939 L. H. Enslow Editor



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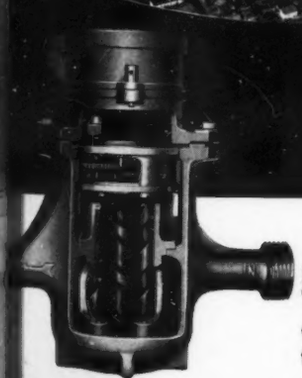

Remember
ISBURGH IMO METERS WEAR IN
WHERE OTHERS WEAR OUT

Lubbock, a thriving city of over 30,000 persons, is located in the vast South Plains of Texas. The territory within a radius of three hundred miles makes Lubbock the financial, educational, trading and transportation center. It may well be proud of the fact that each year for the past eight years it has won the official title, "The Cleanest City in Texas", and that its tax rate is the lowest of any city of equal size in the state of Texas. Lubbock owns its water system. The supply comes from an inexhaustible underground water sheet and is obtained through wells at an average depth of 150 feet.

In keeping with their reputation for efficiency and foresight, city officials long ago were looking for a rugged quiet water meter that would effect savings by accurately measuring the low flows (flows less than 1 g.p.m.). They found their answer in the unique Pittsburgh IMO Water Meter. Built to specifications which guarantee an accuracy of 98% at 1/4 g.p.m., and 90% at 1/12 g.p.m., the Pittsburgh IMO measures those low flows that conventional meters will not record. Considering the proven fact that the average household uses 30% of its water at a rate of flow less than 1 g.p.m., the Pittsburgh IMO Water Meter will facilitate an important increase in total revenue. The complete story is in Bulletin W-529. It will pay you to write for it.

PITTSBURGH EQUITABLE METER COMPANY
MERCO NORDSTROM VALVE CO.
NEW YORK · BUFFALO · PHILADELPHIA · KANSAS CITY · TULSA · LOS ANGELES
Main Offices · PITTSBURGH, PA.
DES MOINES · CHICAGO · COLUMBIA · MEMPHIS · OAKLAND · HOUSTON

OVER 750 CUSTOMERS IN 46 STATES OF THE UNION

LOOK through to the future a century hence, you men who are planning and constructing cast iron underground mains, and what can you be sure of! Just this: cities may be destroyed—mains abandoned or relocated—but there will be a *hundred years or more of useful life* in every length of cast iron pipe, whether it be pit cast or centrifugally cast by the Super-de Lavaud chill-free process.

U.S. cast iron PIPE

Centrifugally or pit cast for water, gas, sewerage, drainage and industrial service.

U. S. PIPE & FOUNDRY CO.
General Offices: Burlington, N. J.
Foundries and Sales Offices throughout the U. S.

NEW SUBSCRIPTION ORDER

WATER WORKS AND SEWERAGE

(THIS IS NOT A RENEWAL NOTICE)

☐ 1 Year $2.00 ☐ 2 Years $3.00

SEND INVOICE AS CHECKED ABOVE

Name .....

Position .....

Department .....

Company .....

Street and No. .....

City ..... State .....

FIRST CLASS
PERMIT NO. [illegible]
(Sec. 510, P. L. & R.)
Chicago, Ill.

BUSINESS REPLY CARD

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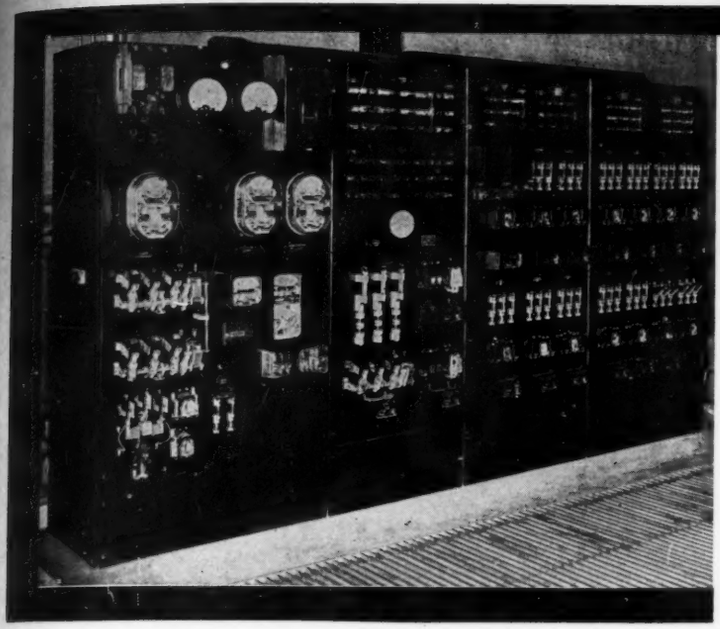
WATER WORKS & SEWERAGE

330 SOUTH WELLS STREET

CHICAGO, ILLINOIS



"3C" CONTROL BOARD

for SEWAGE TREATMENT PLANT, designed for 15,000 POPULATION based on sanitary flow of 100 GALLONS per capita.

¶ This four panel "3C" Control Board controls 200 G.P.M., 600 G.P.M. 1250 G.P.M., and 1500 G.P.M. Pumping units. These in turn are float controlled by a Clark multi-contact Float Switch, so that the capacity sequence may vary from 200 G.P.M. to 3500 G.P.M. in accordance with the demand.

¶ A 30 H.P. gas driven generator is operated with the gas obtained from the sludge.

¶ On this Clark Control Board is mounted all the necessary equipment for controlling and recording the operation of all mechanical units. It is also designed to throw over automatically and utilize energy from a private utility when the gas supply is insufficient to operate the generator.

¶ Sewage treated varies from .6 to 1.95 million gallons per day. 10 hour daily use of gas engine generates about 60 K.W. The plant uses about 140 K.W. daily. 85% of the total power is used in raw sewage pumping ahead of the plant.

¶ *Your water and sewage treatment electrical control problems will receive prompt attention at our nearest office.*

OFFICES IN PRINCIPAL CITIES

THE CLARK CONTROLLER CO.

1146 EAST 152ND ST. CLEVELAND, OHIO

WATER WORKS AND SEWERAGE, August, 1939. Volume 86. Number 8. Published monthly at 330 South Wells Street, Chicago, Ill., by the Gillette Publishing Company. Per copy, 25c. Subscription rate, United States and Canada, $2.00 per year; Foreign, $3.00 per year. Copyright, 1939. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under Act of March 3, 1879.

Can Your City Afford to Treat Ground Water?

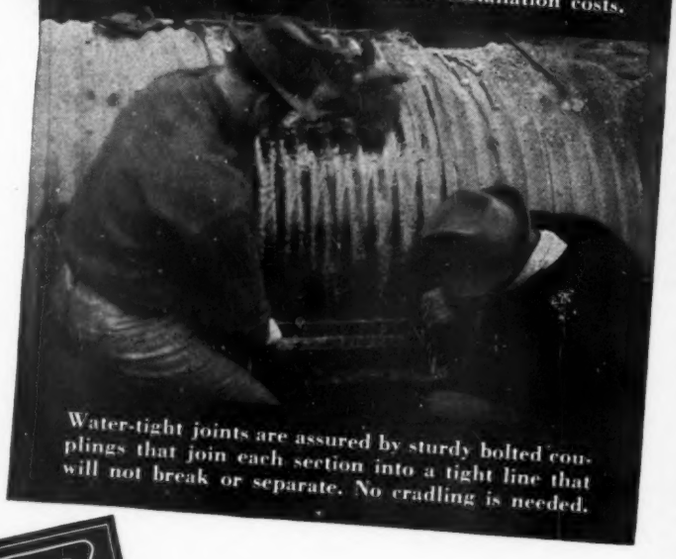
Thousands of dollars can be saved in the cost of maintenance and sewage treatment by using tightly-connected Armco Sewer Pipe wherever a high water table is encountered.

READ THESE FACTS PUBLISHED IN A RECENT ARTICLE

"Flow readings taken at the outlet of a 48-inch sewer laid in 1908 disclosed a maximum discharge of 5.3 *m.g.d.* for an area serving 19,000 people. Since the average water pumpage ran only 2 *m.g.d.* the remainder obviously was due to ground water leakage.

Almost 3.0 million gallons per day of this was eliminated by caulking the joints for a distance of 7,628 feet. This operation cost the city $7,476 and required two years for completion."

There are fewer sources of leakage in an Armco Sewer because its long lengths mean fewer joints per mile. This also helps reduce installation costs.



Water-tight joints are assured by sturdy bolted couplings that join each section into a tight line that will not break or separate. No cradling is needed.

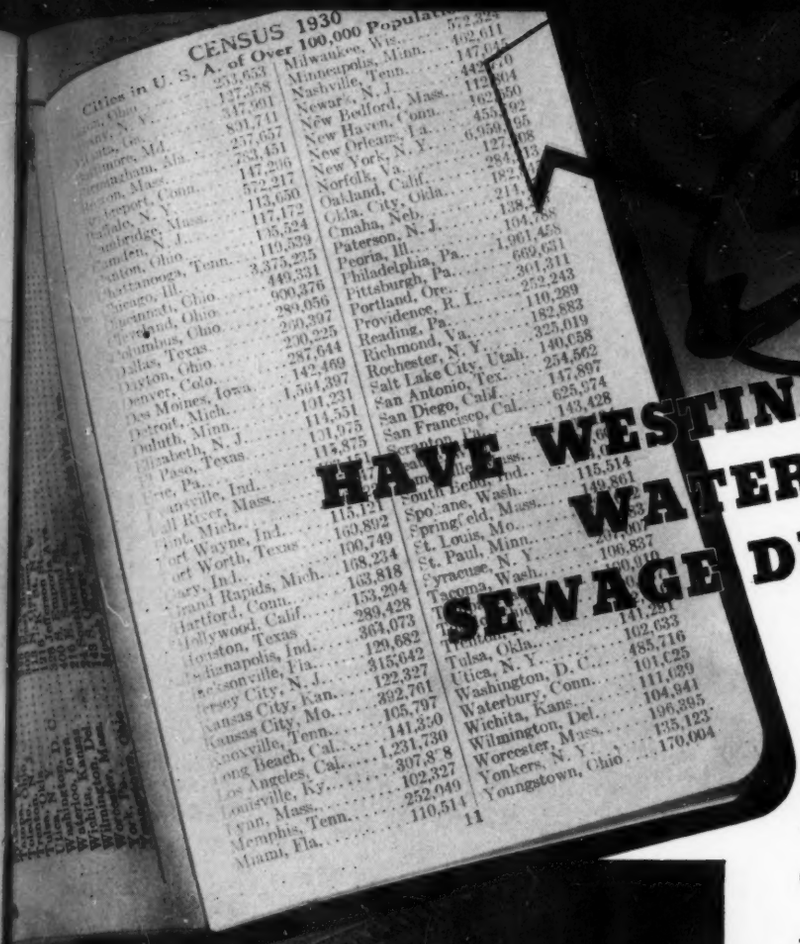
● With State Boards of Health demanding effective treatment of all domestic sewage, it is becoming vitally important to eliminate every possible gallon of ground water leakage into sewers.

To solve this problem economically you need a sewer pipe with strong, water-tight joints; a pipe with enough strength and flexibility to overcome unequal settlement. Yet can you be sure of these results with short sectional types? Some say, yes. Some say, no. But in any event you can be *doubly* certain with Armco Sewer Pipe because its sturdy corrugated iron construction and tightly-coupled joints eliminate all danger of breakage and infiltration.

Besides, Armco Sewer Pipe ends the worry of material failure. Its galvanized iron base already boasts a 32-year service record in sewers. And remember, this pipe is paved in the bottom and fully coated with a special bituminous material inseparably bonded to the pipe. Write for 48-page Sewer Book. Armco Culvert Mfrs. Assn., Middletown, O.

ASBESTOS-BONDED ARMCO SEWER PIPE

A PRODUCT ORIGINATED AND DEVELOPED BY ARMCO ENGINEERS



51% Now 64%

HAVE WESTINGHOUSE EQUIPPED WATER WORKS OR SEWAGE DISPOSAL PLANTS

~~FORTY-EIGHT~~ *Sixty* of the ninety-four U. S. cities with a population of more than 100,000 are served by at least one water works or sewage disposal plant largely electrified by Westinghouse. These cities are assured of dependable, economical operation with Westinghouse equipment because:

1. ***Experienced Westinghouse Engineers*** work hand-in-hand with consulting and city engineers in planning the most up-to-date, tailor made installations.
2. ***Design of Westinghouse electrical equipment*** has been proved in this as well as other industries.
3. ***Unexcelled Testing Facilities*** subjects Westinghouse equipment to punishment far beyond the requirements of actual service.
4. ***36 Service Shops,*** strategically located, assure prompt repairs in emergencies.
5. ***One Source of Supply*** and responsibility for the entire electrical installation because of the diversity of Westinghouse products and close cooperation with the Westinghouse electrical wholesalers' organization.

The Westinghouse representative in a city near you can place these Westinghouse assets at your disposal. Why not call him when planning a new Water Works or Sewage Disposal Plant?

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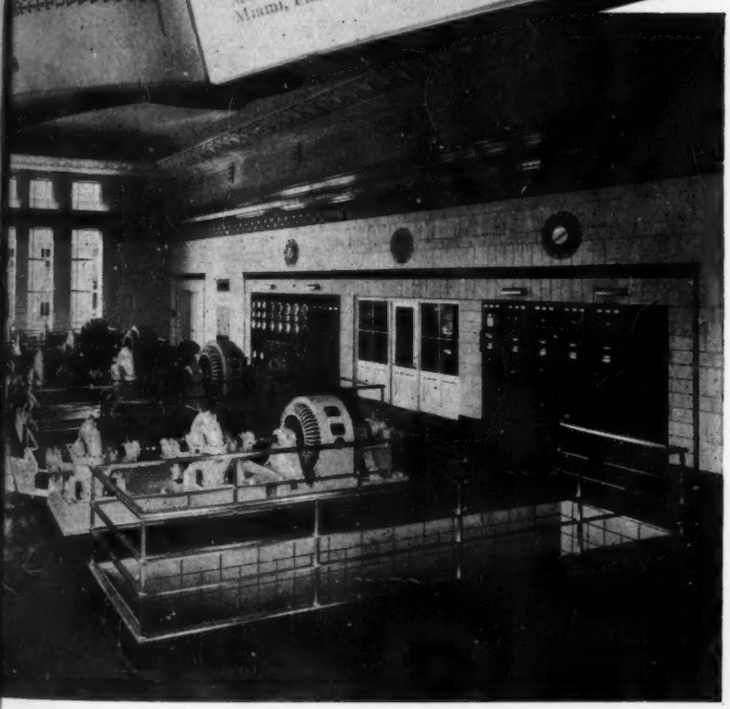
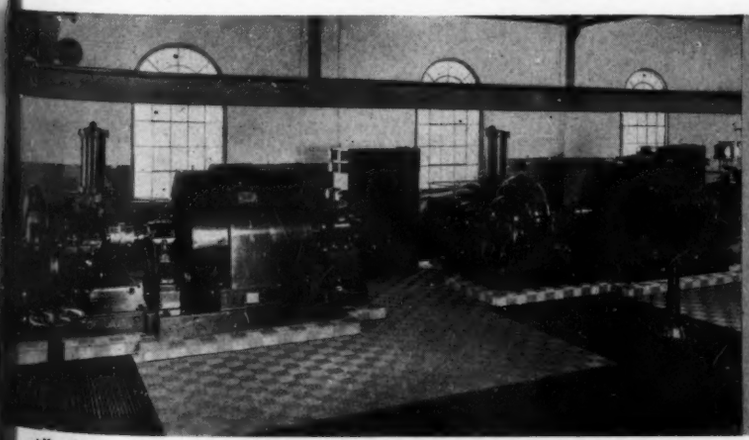
as well as the smallest communities,

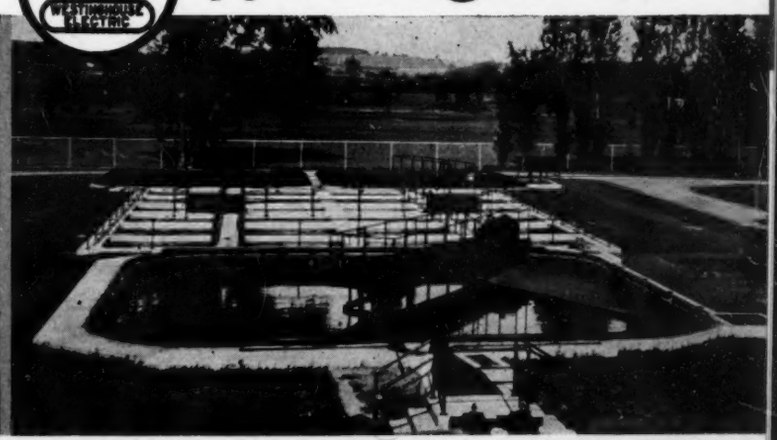


Westinghouse Synchronous Motors and Switchboard are typical of the careful planning of the Western Hills Station, Cincinnati, Ohio.

Westinghouse



All of the electrical equipment for the East Park Booster Station, Philadelphia, Pa., was supplied by Westinghouse

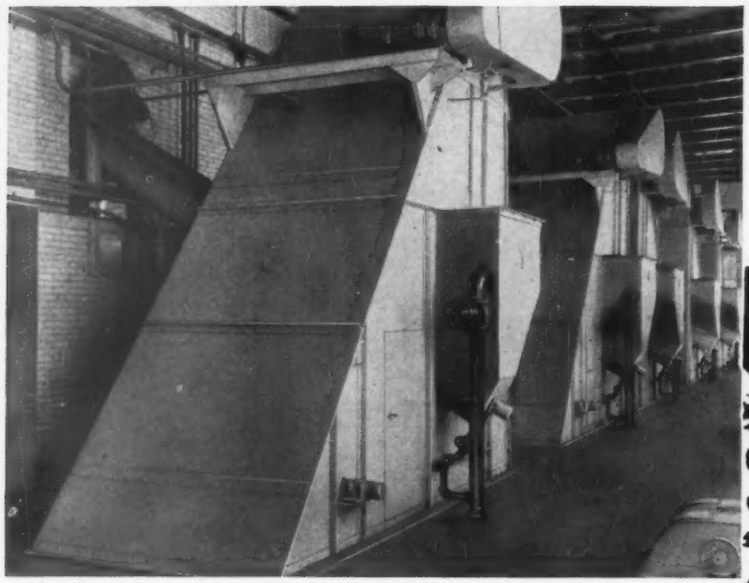


Even in villages such as Newark, N. Y., the dependability of Westinghouse equipment for sewage treatment is being demonstrated daily.

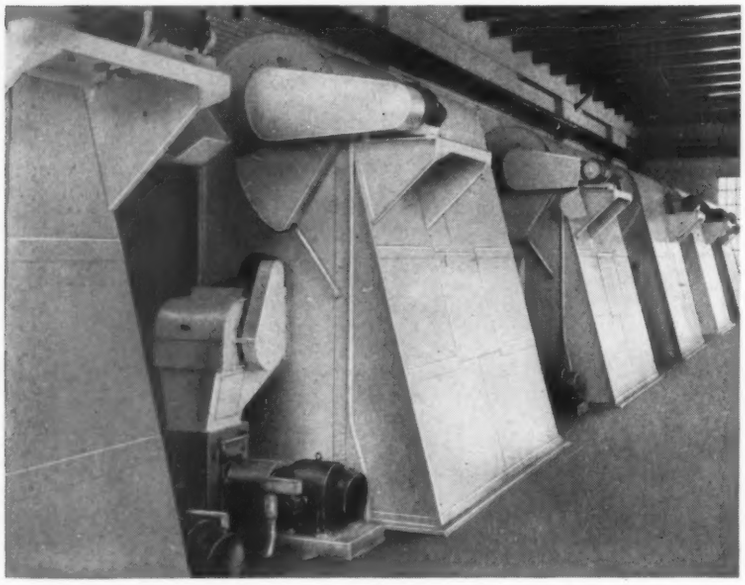
AND NOW *Buffalo!*

ANOTHER OUTSTANDING PLANT TO INSTALL

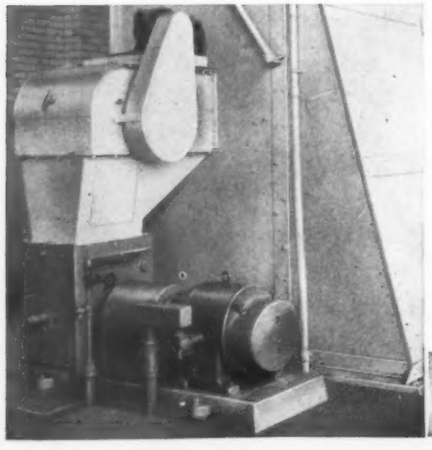
Rex Bar Screens Grit Collectors and Triturators



6 Rex Grit Collectors with 6 separate Rex Grit Washers installed in Buffalo's new sewage treatment plant.



These six Rex Bar Screens handle a flow of 600 M.G.D. Screen channels are each 12' 0" wide by 12' 3" deep.



A belt feeder from each Rex Bar Screen discharges directly into its Rex Triturator. The new Buffalo plant has six of these units.

Here in another of the nation's largest and most up-to-date plants—the new sewage treatment plant at Buffalo, New York—600 M.G.D.—you will find Rex Bar Screens, Grit Collectors and Triturators installed for efficient handling of grit and screenings.

Six Rex Grit Collectors with six separate Rex Grit Washers combine the benefits of mechanical grit collection with removal of excess organic material.

Six Rex Mechanically Cleaned Bar Screens and six Rex Triturators (Shredders) provide the advantages of:

Low head loss through screen
Positive rack cleaning
Low power consumption
Quiet, efficient operation
Rugged, "low maintenance cost" design
Neat, totally enclosed construction

Why not investigate the successful record of all Rex Sanitation Equipment, including Rex Tow-Bro Sludge Removers, Rex Triturators, Rex Grit Collectors and Washers, Rex Conveyor Sludge Collectors, Rex Slo-Mixers and Rex Mechanically Cleaned Bar Screens? For descriptive literature on any of these items, address the Chain Belt Company, 1610 W. Bruce St., Milwaukee, Wis.

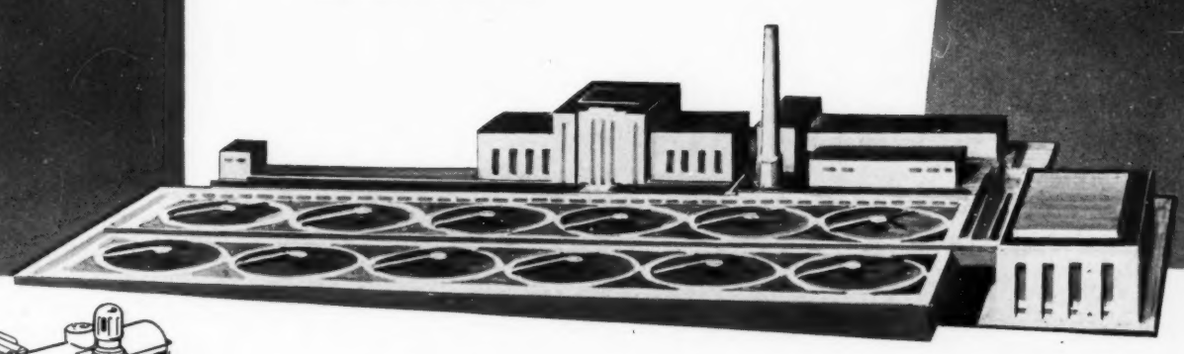
REX SANITATION EQUIPMENT

CHAIN BELT COMPANY of Milwaukee

DIAMOND LIQUID CHLORINE

4 WAY SERVICE FOR MUNICIPAL SEWAGE PLANTS

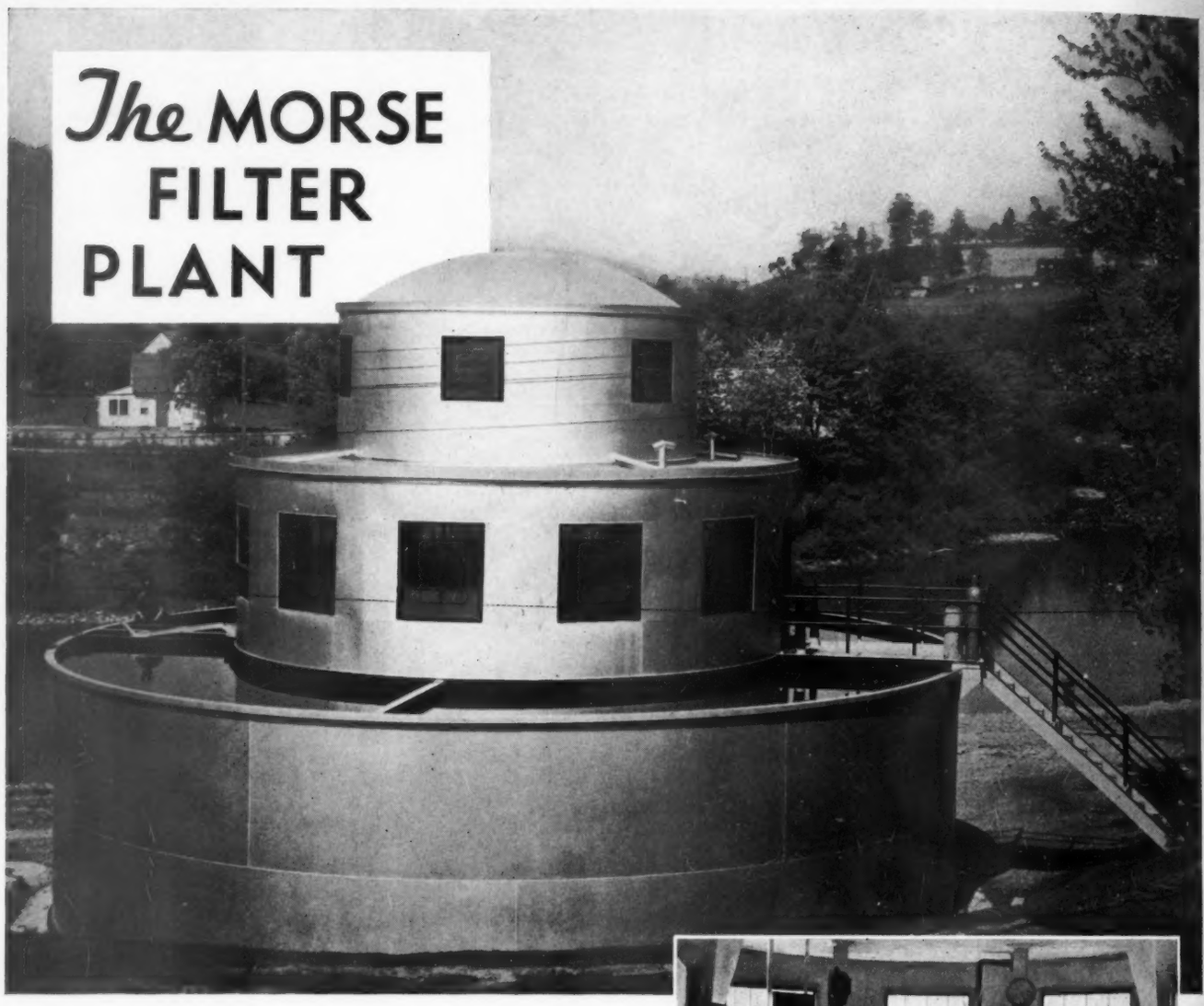
1. **Completely Deodorizes and Sterilizes Municipal Sewage**
2. **Combined with Copperas Makes an Effective Coagulant**
3. **Complete Odor Control and Prevention—Reducing B. O. D. of the Sewage**
4. **Provides Effective Bacterial Reduction of the Effluent Preventing Unnecessary Stream Polution.**



The uniform purity of Diamond Liquid Chlorine in trouble-free containers has made Diamond a preferred Brand among municipal sewage engineers for many years. Quick deliveries of cylinders in 100- or 150-pound capacities are always obtainable through your local Diamond distributor. Larger quantities are shipped direct from the centrally located Diamond Plant at Painesville, Ohio.

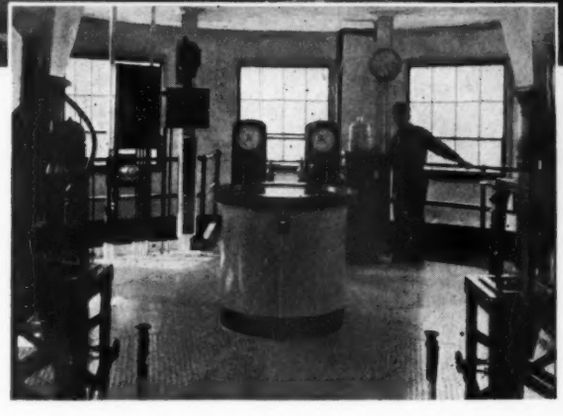
DIAMOND ALKALI COMPANY, Pittsburgh and Everywhere

The MORSE FILTER PLANT



Provides an Effective Combination of Large Capacity and Small Space

AMONG the important advantages offered through the use of the Morse Filter Plant is its ability to provide large capacity in a small area. This is accomplished by the concentric design employed, requiring a minimum of space per m.g.d. of capacity, which is particularly advantageous where large level areas are not available and where land values are high. An excellent example of this feature has been demonstrated recently by the new filter plant illustrated above. This unit was installed for the Citizens Water Company at New Bethlehem, Pa. It has a nominal capacity of 720,000 g.p.d., and yet measures only 49 ft. in diameter. For complete information or estimating figures, please write our nearest office.



Illustrated directly above is an interior view of the Morse unit at New Bethlehem, Pa., showing the operating "circle" with sight well in the center.

CHICAGO BRIDGE & IRON COMPANY

Chicago	2198 Old Colony Bldg.	Birmingham	1586 North 50th Street	Philadelphia	1644-1700 Walnut St. Bldg.
New York	3390-165 Broadway Bldg.	Tulsa	1646 Hunt Bldg.	Boston	1548 Consolidated Gas Bldg.
Cleveland	2262 Rockefeller Bldg.	Houston	2919 Main Street	San Francisco	1083 Rialto Bldg.
Dallas	1479 Liberty Bank Bldg.	Detroit	1551 Lafayette Bldg.	Los Angeles	1455 Wm. Fox Bldg.

Fabricating plants in CHICAGO, BIRMINGHAM, and GREENVILLE, PA.

THESE D-H-S BRONZE STEMS ARE 23 FEET LONG AND SIX INCHES IN DIAMETER—They were furnished the Crane Company for the City of Detroit. Water works engineers can insure positive performance of gates and valves by specifying D-H-S Bronze Stems. The physical properties listed below show this alloy provides the maximum combination of ductility, hardness and strength.

D-H-S No. 2 Bronze

Minimum Physical Properties in Cast Billet

U.T.S.	115,000 #/sq. in.
Yld. Pt.	90,000 #/sq. in.
El. Limit	55,000 #/sq. in.
Elong. 2"	12%
Red. of Area	12%
Brinell Hardness No.	225

COAL TAR PITCH IS THE SAFE MATERIAL FOR MEMBRANE WATERPROOFING—Some materials which are used to waterproof foundations, sludge digestion tanks and other concrete and masonry structures are not resistant to water. That is why it is important to specify Koppers Waterproofing Pitch. It is not affected by either constant or intermittent contact with water.

PRESSURE-TREATED TIMBER USED TO PROTECT MEMBRANE WATERPROOFING—The machinery pits in pumping stations in the Baltimore water system are often below ground with the water level rising close to the ground line. The underground walls of these pumping stations are waterproofed. To protect the membrane waterproofing, a double wall of wooden sheathing was built against the membrane waterproofing. Untreated wood was first used in these double walls, but it was quickly found that it decayed in a few years. When the Ashburton Pumping Station was built, pressure-treated oak boards were used in place of the untreated wood. This provides permanent protection.

KOPPERS

DOES A BETTER JOB FOR YOU

KOPPERS *products*

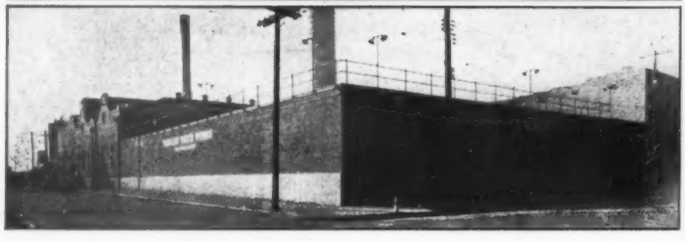
American Hammered Piston Rings . . . Tarmac for Paving . . .
Waterproofing and Gasproofing . . . Pressure-treated Timber
. . . Engineering and Construction Work . . . Bituminous-base Paints

KOPPERS COMPANY • PITTSBURGH

MATHIESON

GIVES VALUED SERVICE TO MUNICIPAL WATERWORKS

Earl Mitchell, Superintendent of Filtration, Paducah Waterworks, Paducah, Kentucky—watching a cylinder of Mathieson Chlorine at work in the Paducah Chlorine Room.



Says Mr. Mitchell:

"We have used Mathieson Chlorine for the past eight years and Mathieson Ammonia and HTH for the past three years.

"During that time, we have been well pleased with your products, both from the standpoint of service and the condition of the cylinders on arrival. We have never received any dirty cylinders of chlorine or cylinders with sticky control valves.

"We use chlorine both for pre-chlorination and post-chlorination, and ammonia to help maintain the chlorine residual at all points in the distribution system. We use HTH in sterilizing new mains and in sterilizing filter beds, with perfect satisfaction."

Paducah's experience with Mathieson waterworks-sanitation products is typical of that of many cities throughout the length and breadth of the United States.

Mathieson Chlorine and Mathieson Ammonia have proved, through years of satisfactory service, their thorough purity and dependability. And not least important, from a practical point of view, is the fine service record of Mathieson's safe, trouble-free cylinders and valves.

Mathieson HTH—a dry, free-flowing chlorine carrier containing 70% available chlorine—has an equally impressive record. Many cities keep a supply of Mathieson HTH constantly on hand not only for such everyday jobs as sterilizing new or newly-repaired mains, but for many special and emergency jobs where a mobile, high test chlorine carrier is required.

HTH comes in 5-lb. cans with replaceable caps, packed 9 cans to the case; also in 75-lb. drums.

THE Mathieson Alkali Works (INC)

60 EAST 42ND STREET, NEW YORK, N. Y.

LIQUID CHLORINE . . . HTH . . . SODA ASH . . . CAUSTIC SODA . . . BLEACHING POWDER . . . BICARBONATE OF SODA . . . AMMONIA, ANHYDROUS and AQUA . . . PH-PLUS (FUSED ALKALI) . . . DRY ICE . . . LIQUID CARBON DIOXIDE

2nd FEATURE OF AN EFFICIENT, LOW-COST WATER SYSTEM

EXCEPTIONAL RESISTANCE TO CORROSION

IN ALKALINE SOILS, such as those encountered in arid regions, Transite Pipe has established an outstanding service record. And the inside stays smooth indefinitely . . . keeps pumping costs at permanently low figures.

MORE than 40,000 miles of asbestos-cement pipe in service all over the world have proved its exceptional resistance to soil corrosion, its immunity to electrolysis. Laid in all kinds of soils, carrying all types of water, J-M Transite Pipe provides long, virtually trouble-free service that keeps maintenance charges at minimum figures.

And Transite provides every other advantage necessary for low-cost water transportation. It is strong and durable, yet unusually light in weight . . . provides definite savings in handling expense. Simplex Couplings make assembly rapid and economical, form permanently bottle-tight joints. And, because of its asbestos-cement composition, Transite's initial high flow coefficient of C=140 can never be reduced by rust or tuberculation.

The many advantages of this modern, asbestos-cement pipe have led to its wide use in important water-distribution systems. For example, more than 10 miles of Transite Pipe (over 78% of all water lines) have been laid in the grounds of the New York World's Fair. For full details on Transite's 25-year service record, send for the Transite Water Pipe brochure TR-11A. And, if sewage disposal is your problem, ask for the Transite Sewer Pipe brochure TR-21A. Write Johns-Manville, 22 East 40th Street, New York, N. Y.

IN SALT MARSHES and aggressive cinder fills, J-M Transite Pipe assures maximum service at minimum upkeep expense. Furthermore, this modern material is light in weight, easy to handle and assemble, provides good-sized savings at installation.

ELECTROLYSIS has absolutely no effect on J-M Transite Pipe. This durable material is entirely non-metallic . . . can be laid near street railways and power lines without danger of disintegration.

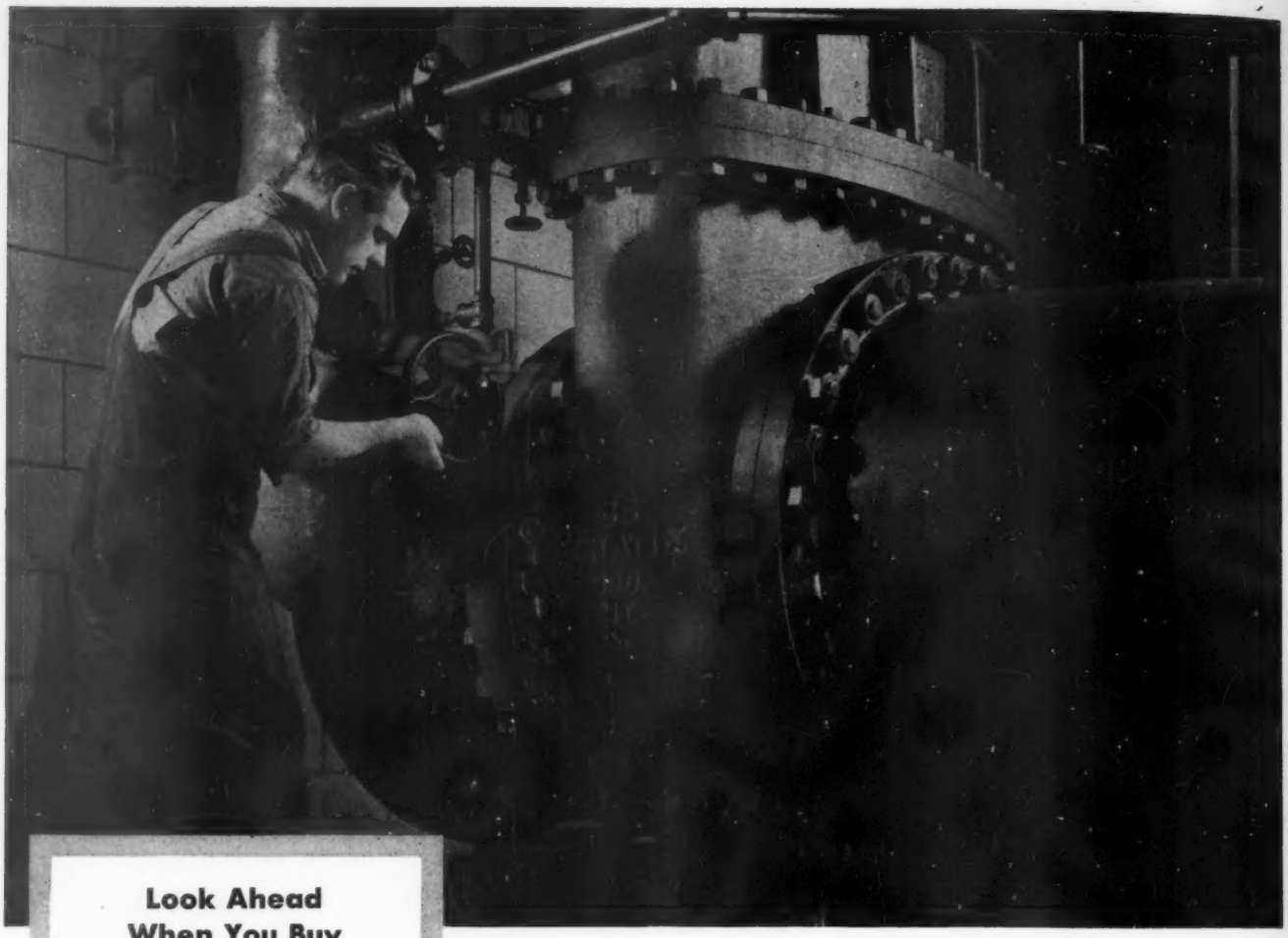
ACID SOILS present no costly maintenance problem when Transite is used. Even in unusually corrosive soils, Transite provides maximum assurance of long life, low maintenance.

JM PRODUCT

Johns-Manville TRANSITE PIPE

AN ASBESTOS PRODUCT

THE MODERN MATERIAL FOR WATER AND SEWER LINES



Look Ahead When You Buy Water Works Valves

Your water system makes your city livable . . . is the life-blood of its industry. It's the true foundation of your city's future. Be mindful of this when you buy water works valves—be sure they'll meet tomorrow's needs.

And they will—if you choose Crane No. 480½ A. W. W. A. double disc gate valves. They're built to give that kind of service—scientifically designed for positive action . . . smooth, yet tight and true—through long years ahead.

Ask your Crane Representative for all the money-saving advantages of the Crane No. 480½.

BIG VALVES FOR BIG JOBS IN FLOW CONTROL

WHERE the big job requires a big valve there is, in the Crane line, a valve of just the right size, just the right design to handle it. Here, for example, is a 36-inch gate valve chosen by the waterwork engineers of a large mid-western city to control the flow of water from the pumps into the city mains. It's Crane, of course, for Crane quality is well recognized by experienced engineers as a highly desirable plus value in valves where the requirements are a little exacting—the service a little tougher.

But important as big valves for big jobs are in flow control—little valves for big jobs are important, too. For example ½-inch valves, that just make a handful, control the service line shut-off into homes—special plug disc valves handle the chlorine and give greater resistance to the corrosive action of this gas. But whether it is a valve so large a man can walk through it or so small you couldn't use it for a finger ring—the Crane line covers them all.

Regardless of your requirement—if it is valves, fittings or piping for waterworks or sewage treatment service—you will find it in the Crane line. Turn to your Crane No. 52 Catalog for the details about 38,000 items. Among them you will find an answer to practically any piping problem which you may have. You will also find a large amount of engineering data which may prove very desirable to have handy.

CRANE

CRANE CO., GENERAL OFFICES
836 S. MICHIGAN AVE., CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

How to NOT Soften Water

New Treatment with CALGON prevents scale and helps to control corrosion

HOW CALGON PREVENTS PRECIPITATION

Both bottles hold water containing 200 parts per million calcium bicarbonate to which has been added 200 parts per million soda ash.
A. With Calgon, showed no precipitation after 5 days' time.
B. Without Calgon, became cloudy within 5 minutes as a result of precipitation of calcium carbonate.

IS YOUR WATER HARD?
Then you do *not* want softening to occur in the mains or in the hot water heaters of your customers.

IS YOUR WATER SOFT?
Then you do not want further softening to occur when you add alkali for corrosion control.

IS YOUR WATER SOFTENED?
Then you do *not* want further softening to occur in the filters, mains, meters and hot water heaters.

How do we prevent the softening of water? By applying "Threshold Treatment"—the addition of one part of Calgon per million parts of water. This inexpensive treatment prevents scale and helps to control corrosion in all parts of the system.

"Threshold Treatment" with Calgon has already proved successful in a great many municipal and industrial plants. Send the coupon for additional information.

CALGON, INC.
A SUBSIDIARY OF HAGAN CORPORATION
Chemical and Combustion Engineers

Calgon, Inc., 300 Ross St., Pittsburgh, Pa.
Gentlemen: Please send information about Threshold Treatment. I am interested in preventing scale ☐ Controlling corrosion ☐.

Name.....
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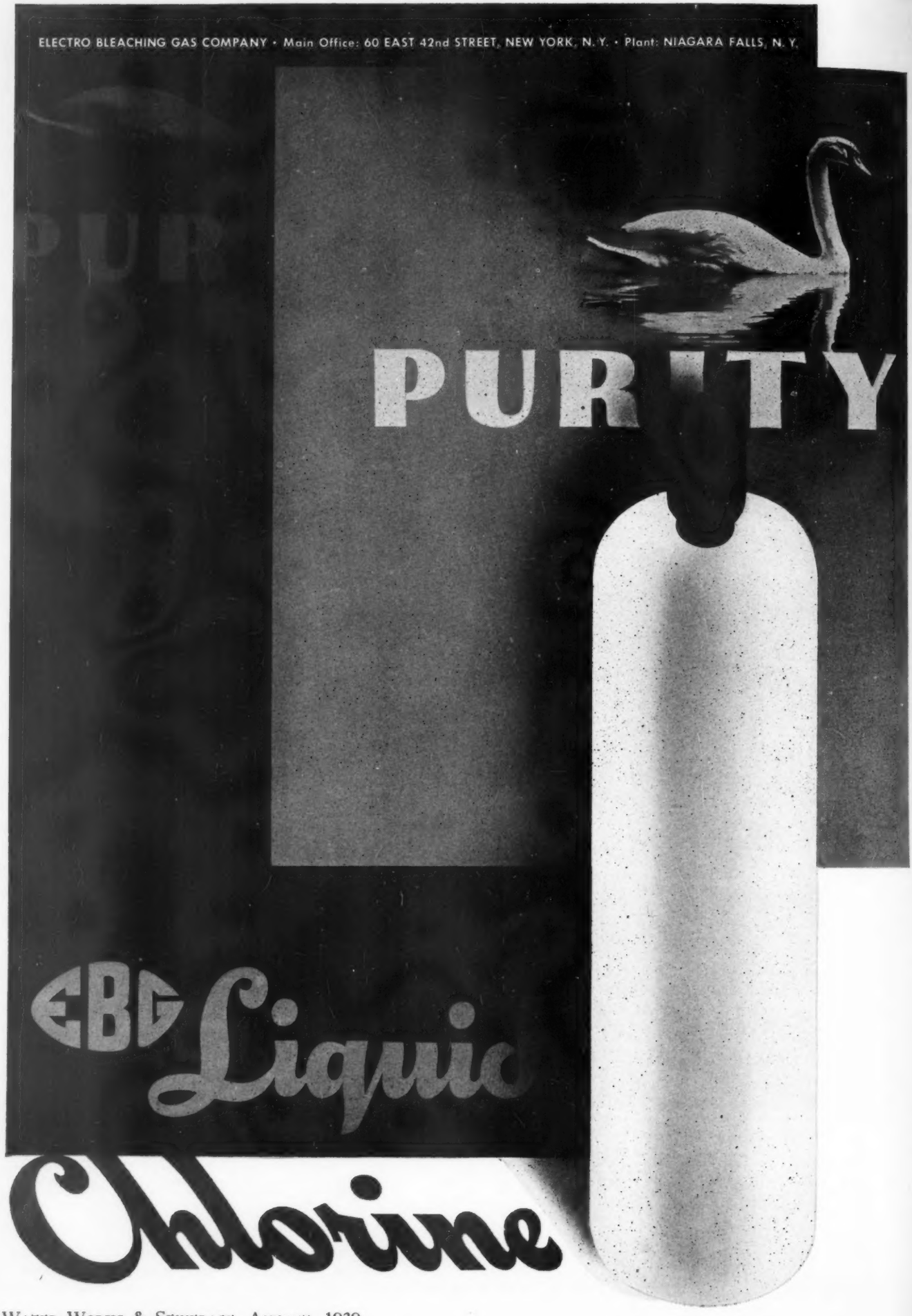
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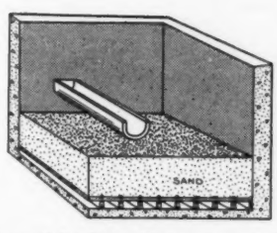

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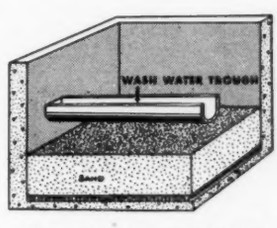

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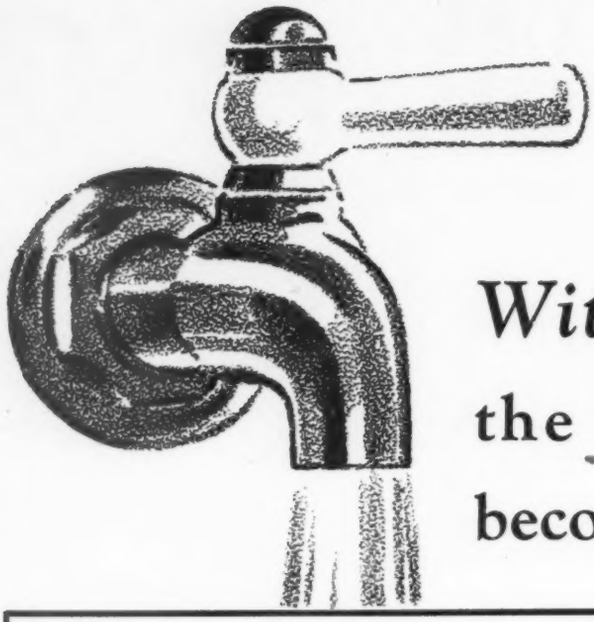

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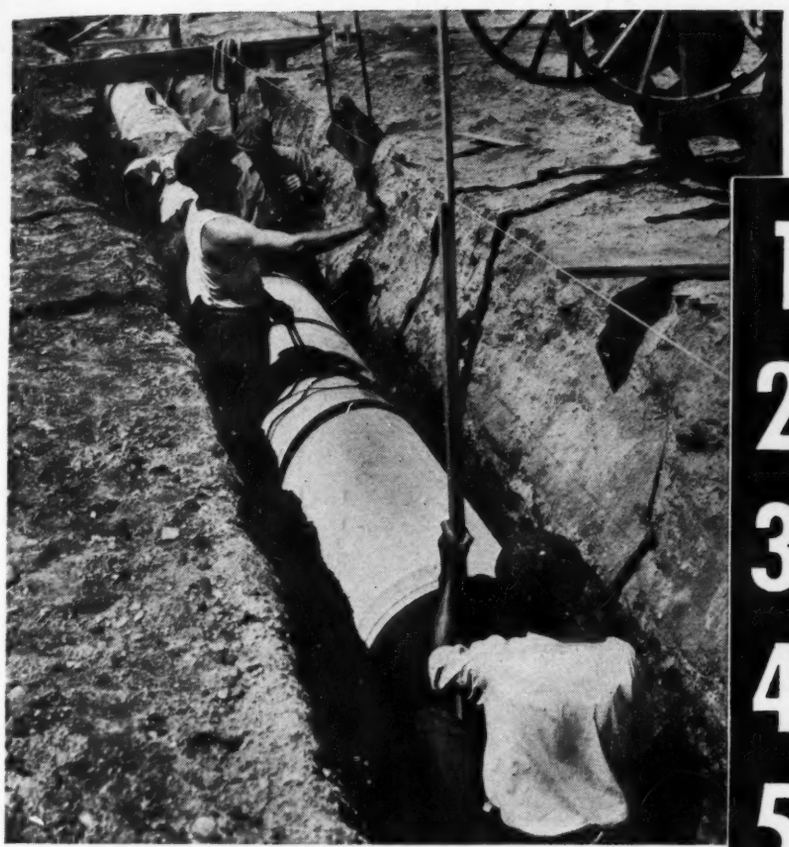

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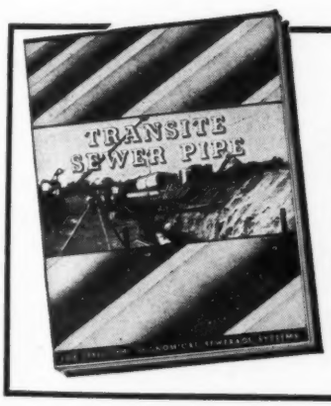

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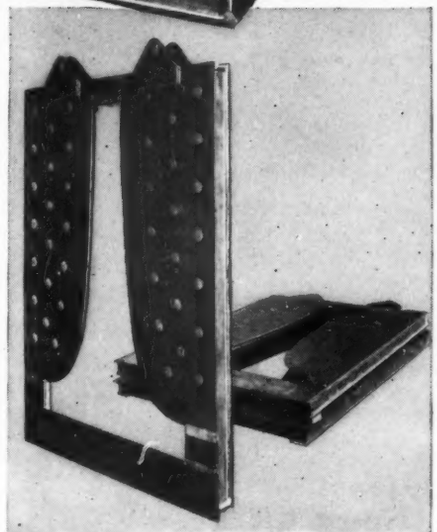

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WATER WORKS & SEWERAGE

Published Monthly by Gillette Publishing Company

PUBLICATION OFFICE
330 South Wells Street Chicago, Ill.
E. S. Gillette, Publisher

EDITORIAL OFFICE
155 East 44th Street New York, N. Y.
L. H. Enslow, Editor

Coming! Articles

"On—Watching the Cash Register"
Wherein a successful superintendent presents the results of his studies and an analysis of the true economic aspects of meter testing. He has studied the problem from the standpoint of justified frequency of testing; repair limitations; and other considerations determining what constitutes over-all economy in the practices of his own Meter Department. In his findings facts have upset questioned fancy. In consequence, the cash register totalizer may have shown no handsomer figures, but the difference between gross receipts and expenditures is another story.

"Recarbonation by Submerged Combustion"
Is the story of a "flame that never fails". For some time the heating and evaporation of liquids has been successfully accomplished by under-water gas burning. This scheme has now been successfully applied in the recarbonation of lime softened water at Oklahoma City. Strange sight to look down through 10 or more feet of water at blue gas jets uninterruptedly burning—that's the thrilling part. The practical aspect is the simplicity of the scheme of producing carbon-dioxide at the spot of absorption thus reducing equipment and maintenance to a minimum along with costs.

"Incineration of Screenings"
In our June issue an article described the scheme and equipment involved in grit and coarse and fine screenings disposal at Milwaukee—involving centrifugal dewatering and incineration in a new multi-hearth destructor. In a follow-up article is set forth operating experiences, performance of equipment, and costs of the method as compared to earlier and less successful operations.

"The Romance of Gas Utilization"
Might well be the title of an article which will review experiences and results from the utilization of digester gas in power generation at New York City plants, since the cutting of the electricity utility lines at the Coney Island Plant to the largest sludge gas power development in America, that of the Tallmans Island Plant, where auxiliary gas engine fuel is taken as needed from a utility gas line automatically—no stand-by or ready to serve charge being made.

"A Unique Method of Spotting Water Waste, or Water Stealing"
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Authors

D. R. TAYLOR, Supt. Water, Roanoke, Va.
L. H. SCOTT, Supt. Filtration, Oklahoma City
and
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JAS. L. FEREBEE, Chief Engr., Milwaukee Sewerage Commission
RICHARD GOULD, Chief Engr., Dept. of Public Works, N. Y. City
D. D. GROSS, Chief Engr., Denver Water Board
JOHN T. CAMPBELL
The Chester Engineers, Pittsburgh

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Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under the Act of March 3, 1879. Published monthly at 330 S. Wells Street, Chicago, Ill. Per Copy, 25c. Subscription rates, United States and Canada, $2.00 per year; Foreign, $3.00 per year.

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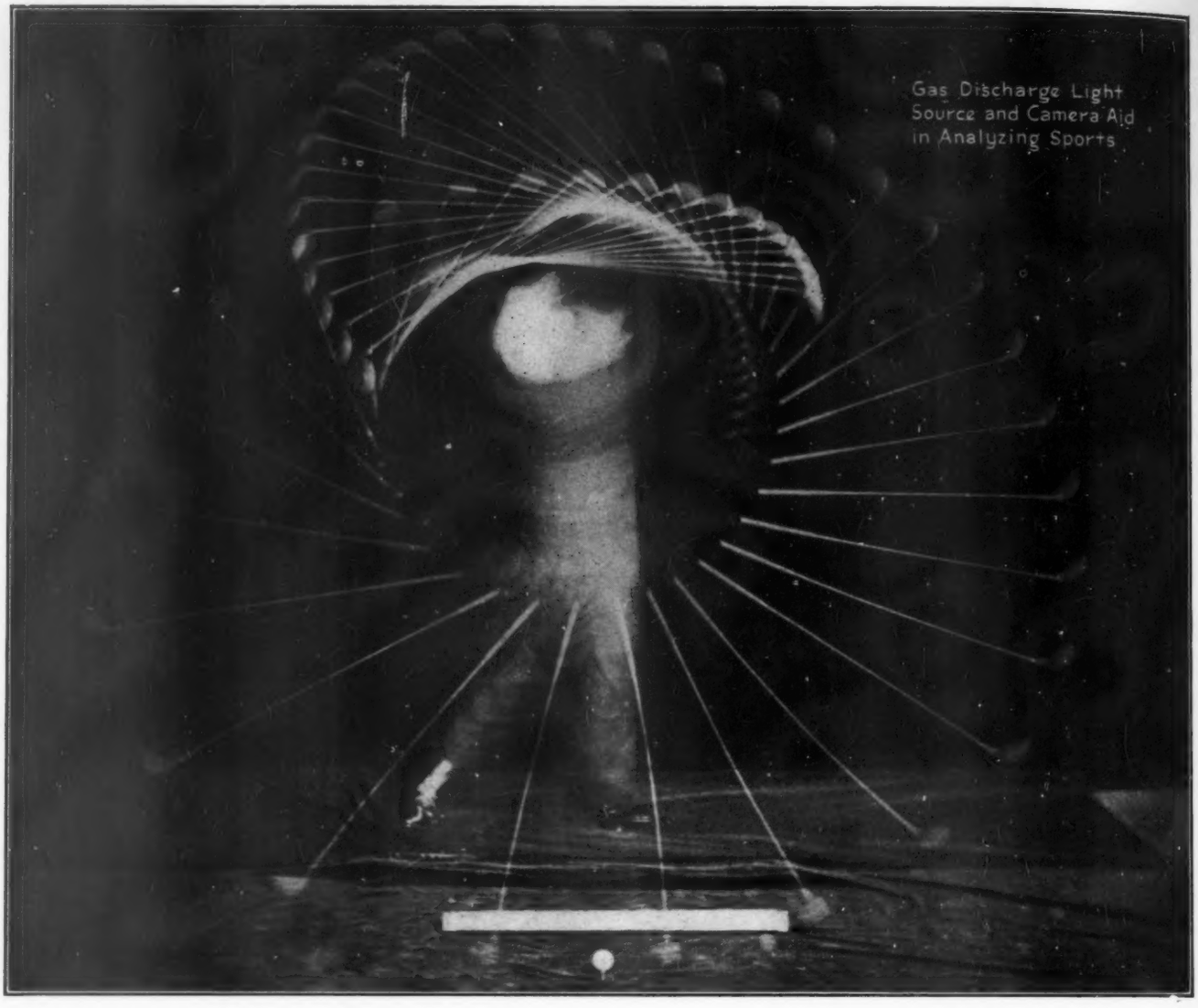
Chicago Office, 330 S. Wells Street. Cleveland Office, 1217 St. Charles Avenue, Lakewood, Ohio. New York Office, 155 East 44th Street. San Francisco Office, 155 Montgomery Street. Los Angeles Office, 318 W. Ninth Street.

Addresses will be changed as frequently as requested, upon notification at least 2 weeks before date of the next issue, in order to be effective for next number. Immediate notice should be given of any delay in receipt of magazine.



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WATER WORKS & SEWERAGE

VOL. 86, NO. 8 — *A Gillette Publication* — AUGUST, 1939

FLOW OF WATER IN PIPE GRID SYSTEMS

By RICHARD G. TYLER*

University of Washington

SEATTLE, WASH.

HARDY CROSS'S method of solving problems of flow of water in pipe systems has greatly simplified their solution and has supplied the means of checking up existing data on pipe flow now used in water works design. Data on the pressure drop produced in symmetrical pipe grid systems by fire drafts of varying amounts from one or more centrally located fire hydrants may be taken as a case in point. A graph giving head losses for grids of various pipe diameters appeared in the 1925 American Water Works Association Manual "Water Works Practice," p. 308, and is typical of the design data in present use. The writer undertook to check this graph by the application of the Hardy Cross method to the same grid system. Fig. 1 shows the pipe lay-out for 1, 2 and 4 fire hydrants. It is assumed that the inflow rate at distances of five-500-ft. blocks in any direction from the point of discharge is equal in all pipe lines as shown. For flow from a single hydrant, one-quarter of the discharge comes from each quadrant, so only the pipe system in the quadrant *aoa* need be considered. For flow from the two hydrants *O* and *P* the pipe system to the left of *bxb* is tributary to *O*. For four hydrants, *O* receives water from the quadrant *cxc*. Table I. gives the corrected discharge of each pipe for balanced flow from 1, 2 and 4 hydrants. In applying the Hardy Cross method for balancing these flows, four trials gave sufficient accuracy for all practical purposes, while only three were required for draft from four hydrants. The computations using the Hazen-Williams formula are onerous but graphs on log-log paper for

$$h = rQ^{1.85}$$

and

$$R = 1.85rQ^{0.85}$$

greatly reduce the time

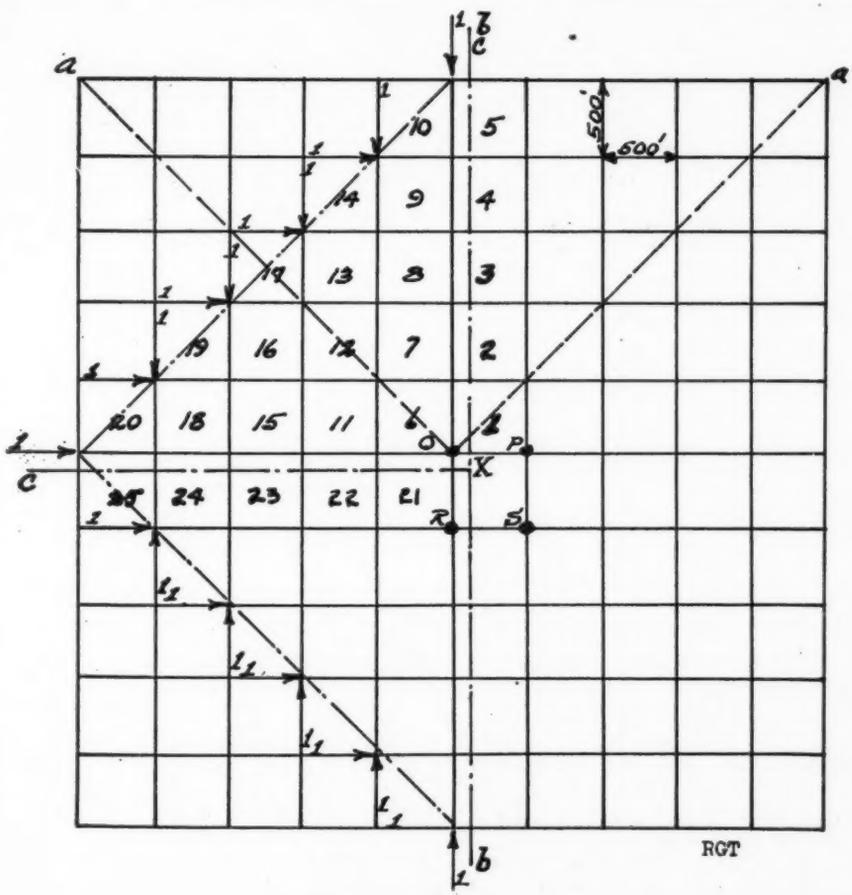

Fig. 1.—Grid Systems

(Showing location of fire hydrants and assumed unit inflow at points 2500 ft. distant from hydrants.)

*Professor of Sanitary Engineering.

and work required. Since all pipes are of equal diameter and length, r may be taken as *one*. Head losses and flow distribution for any draft can be found by multiplying the unit values given in Table I. by the appropriate factor as hereinafter explained. The detailed computations are not shown since the following published papers have described them in detail.

"Analysis of Flow in Networks of Conduits or Conductors," Hardy Cross, Bul. 286, Univ. of Ill., Eng. Exp. Station, 1936.

"Simplified Analysis of Flow in Water Distribution Systems"—J. J. Doland; Eng. News-Record, Vol. 117, p. 475.

"Analyzing Flow in Pipe Networks"—Gordon M. Fair. Eng. News-Record, Vol. 120, p. 342.

In applying successive corrections to these grid systems, it was noted that a correction applied to one small circuit affected adjacent circuits, sometimes changing the algebraic sign of the correction to be made. Different combinations of flow may give approximately equal head losses and an additional correction by the Hardy Cross method will give somewhat different flows without an appreciable change in the total head loss.

Computing Pressure Drop Simplified—

An accompanying graph (Fig. 2) gives the pressure drop in the selected pipe system for a wide range of drafts. This graph is constructed for pipes of from six to twelve inches in diameter, 500 ft. on centers both ways, and with flow from one, two and four fire hydrants. The computations for the various pipe sizes and discharges are easily made by substituting the desired discharge for the unit figures shown in Table 1. For example, in determining the pressure drop for a fire flow of 2000 gpm from a single fire hydrant on an 8-inch grid system, one would proceed as follows:

Since one-fourth of the total flow, or 500 gpm, approaches the hydrant from each quadrant, this 500 gallons is equivalent to the 9.0 units in Table 1. In the next block 3.54 units would therefore equal 197 gpm, while the flow in the next three sections of this pipe as we go further from the hydrant is 122, 91, and 56 gpm, respectively. Head losses for each of these flows through 500 feet of 8" pipe are taken from some of the graphs in current use, giving a total head loss of 5.32 ft. in the straight 2500 ft. of pipe leading to the hydrant. Similarly, if it is desired to check this head loss by that along some other path as, for example, the zigzag line following most closely the diagonal which separates the quadrants, the latter's loss is found to be 5.24, which checks the above figure quite closely. In similar fashion, the losses were determined for other desired flows for the various pipe diameters and number of hydrants shown, and the results have been reproduced in Fig. 2, giving the data in a form for convenient use. These computations are facilitated by constructing a graph on log-log paper, giving the relationship between Q and h per thousand ft. for the pipe sizes used.

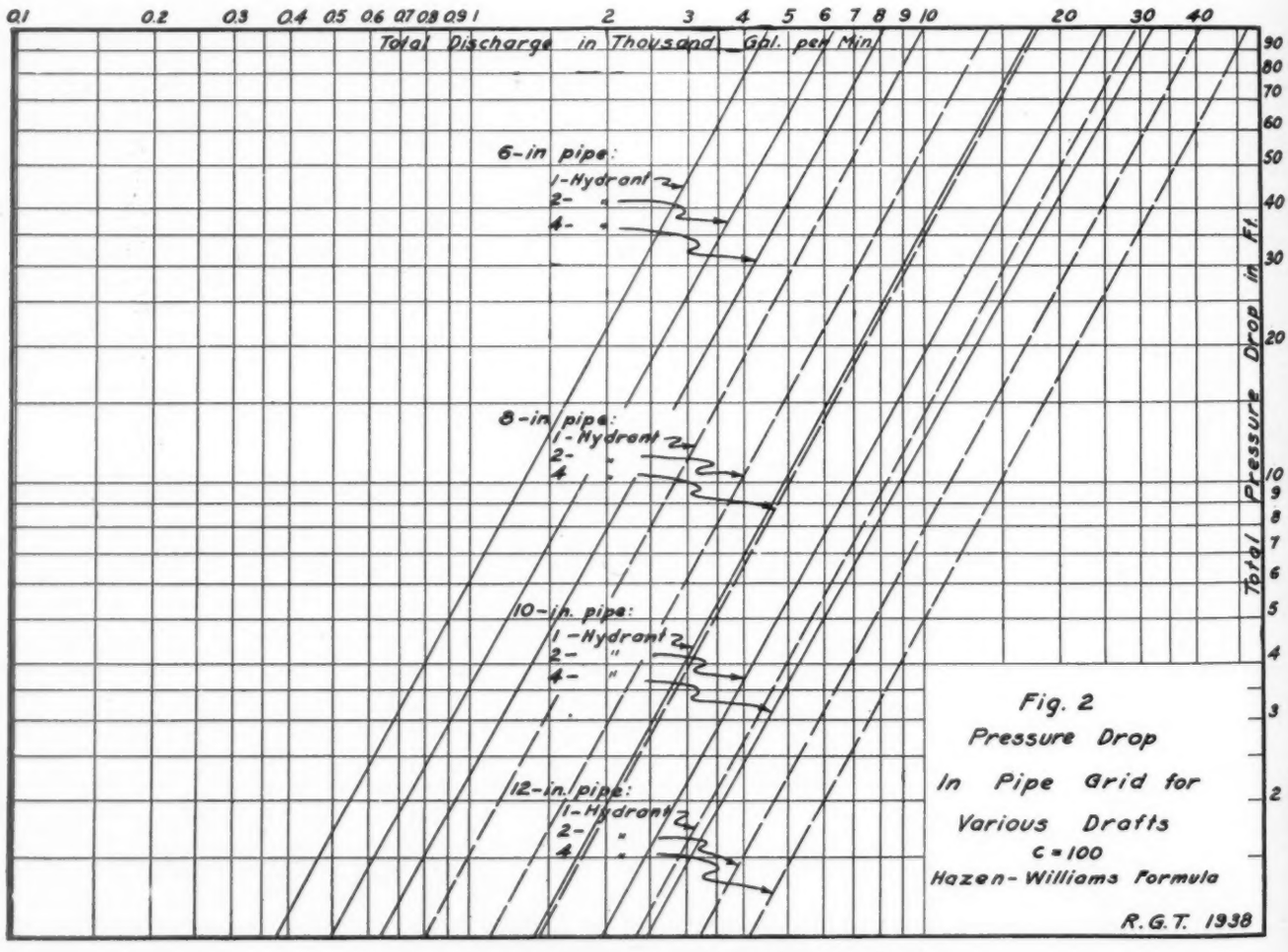

Fig. 2.—Pressure Drop in Pipe Grid for Various Drafts
(*By Hazen-Williams formula assuming* $C = 100$)

TABLE I—Flow in Pipes of Symmetrical Grid Systems for Inflow Shown in Fig. 1 (Adjusted)

Line	Number of Fire Hydrants in Service		
	1	2	4
1- 6	9.00	6.25	5.00
2- 7	3.44	3.23	2.89
3- 8	2.34	2.06	1.95
4- 9	1.70	1.49	1.51
5-10	1.00	1.00	1.00
21- 6	9.00	6.50	5.00
6- 7	2.78	3.02	2.11
7- 8	0.55	1.17	0.94
8- 9	0.32	0.57	0.44
9-10	0.35	0.49	0.51
6-11	2.78	1.65	2.11
7-12	2.78	2.16	2.11
8-13	1.89	1.71	1.77
9-14	1.65	1.51	1.49
22-11	3.44	3.20	2.89
11-12	2.78	2.51	2.11
12-13	1.44	1.62	1.28
13-14	0.56	0.77	0.72
11-15	0.55	0.53	0.94
12-16	1.44	1.13	1.28
13-17	1.44	1.23	1.28
23-15	2.34	2.14	1.95
15-16	1.89	1.91	1.77
16-17	1.44	1.52	1.28
15-18	0.32	0.25	0.44
16-19	0.56	0.48	0.72
24-18	1.70	1.64	1.51
18-19	1.65	1.68	1.49
18-20	0.35	0.32	0.51
25-20	1.00	1.00	1.00

After having determined the position on the graph for a given pipe size, lines representing flow conditions for pipes of other diameters with the same number of hydrants will be parallel thereto on log-log paper and the spacing between them and the computed line will be in inverse proportion to the fifth powers of the respective diameters, regardless of whether the Chezy or the Hazen-Williams formulas are used. Thus, if the 8″ pipe losses are taken as a basis, head losses in a similar 6″ system may be obtained by multiplying values by $\frac{8^5}{6^5}$, or 4.21. The curves in Fig. 2, however, were constructed by computing several points on each curve from the data in Table 1. Curves based on the formula $h = f \frac{l}{d} \frac{v^2}{2g}$ check these curves almost exactly and make the computations much simpler since $n = 2$ instead of *1.85*.

The Circle Method

It is of interest, also, to check the accuracy of another of the earlier methods which has been frequently used by designers of water works systems. This is the *circle method* which has the advantage of simplicity of computations. It is too well known to require a detailed description here. Fig. 3 illustrates its application to the present grid system with flow from a single fire hydrant. In this figure, to simplify the computations, the radii are taken so that the curves cut just inside of the pipe intersections. For example, Curve 1 cuts a single 8″ pipe within the quadrant shown so that for 4000 gpm discharge from the hydrant, this 500-ft.

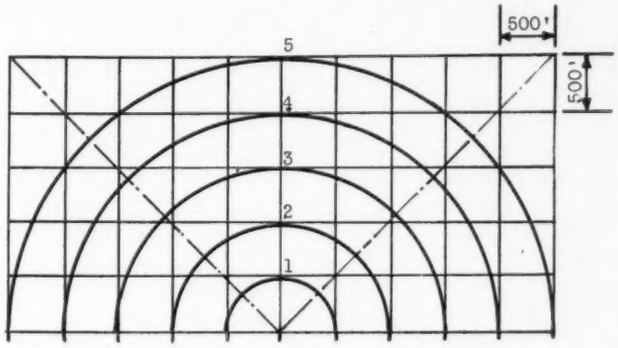

Fig. 3.—The Circle Method of Computation
(*Showing pipes cut in a single quadrant.*)

length of pipe carries 1000 gpm with a head loss of 13.5 ft. Curve 2 cuts three pipes, and since the total length of pipe between Circle 1 and Circle 2 equals 2200 ft., this would give an average length of 733 ft. for the three pipes cut, each carrying one-third of the 1000 gallons with a head loss of 2.6 ft. The other computations are shown in Table II, and it is apparent that the total pressure drop, as determined by the circle method, is 18.2 ft., while the corresponding value taken from Fig. 2 is 19.0 ft. Computations for other discharges give results that check within a similar range of accuracy.

Comparing Tables I and II and Fig. 2, the errors introduced in assuming equal flow through the various pipes between adjacent circles is apparent. These errors, plus and minus, are averaged by totaling the pipe lengths between circles and dividing this total and the total flow by the number of pipes cut. The errors balance to some extent so that the final results obtained by the circle method check approximately the data from the curves in Fig. 2.

For regular grid systems such as those dealt with in this discussion, it is far simpler to use the circle method in preference to the Hardy Cross method. And, when its accuracy is sufficient for the problems under consideration its use is justified, but where greater accuracy is required the Hardy Cross method should be used.

TABLE II—COMPUTATIONS ILLUSTRATING USE OF CIRCLE METHOD OF DETERMINING HEAD LOSSES IN PIPE SYSTEMS

CIRCLE	Total Length Ft.	No. Pipes Cut	Length Per Pipe Ft.	Diam. In.	Discharge Per Pipe gpm	Head Loss Per 1000 Ft.	TOTAL Head Loss Ft.
1	500	1	500	8	1000	27	13.5
2	2200	3	733	8	333	3.6	2.6
3	3900	5	740	8	200	1.5	1.1
4	5400	7	771	8	143	0.83	.6
5	7000	9	778	8	111	0.5	.4

Total Pressure Drop = 18.2
Value from Fig. 2 = 19.0

The larger part of the pressure drop naturally occurs in the section of pipe nearest the fire hydrant because of the relatively greater discharge in this pipe. In fact, for flow at a single hydrant an average of 75.0% of the total pressure drop occurs in this section of the pipe for all diameters and for 500 ft. pipe spacing. Fig. 4 gives the head losses at varying distances from the point of draft and for discharges from 1, 2 and 4 hydrants.

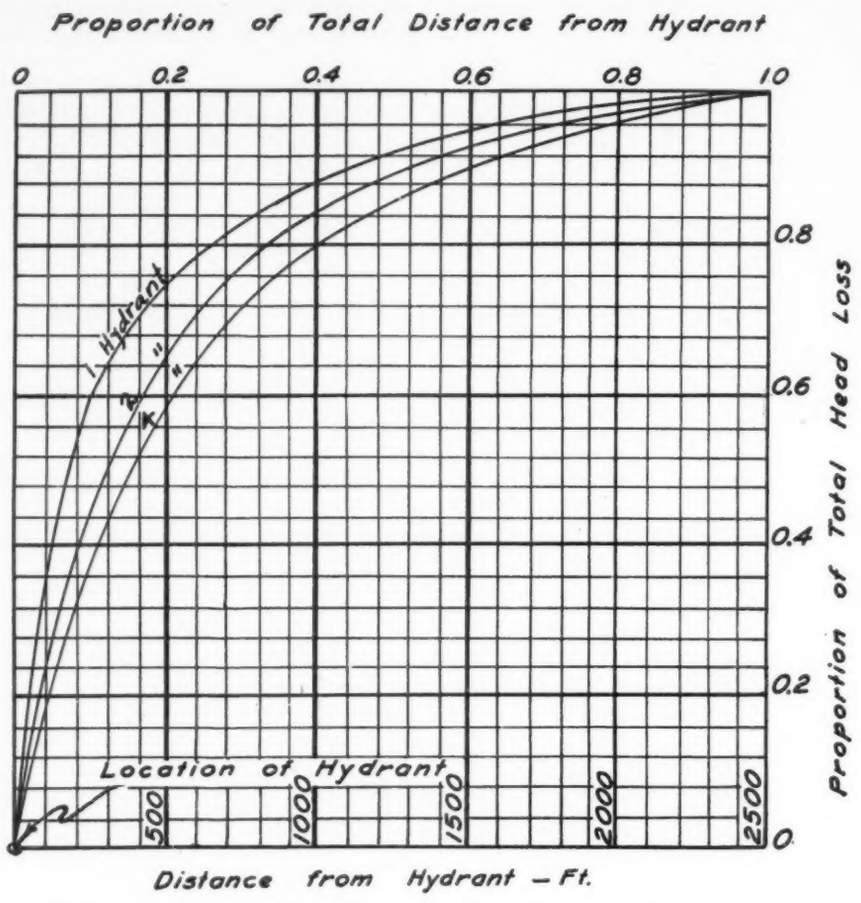

Fig. 4.—Relationship of Pressure Losses to Distances from Hydrants

Obtaining a Close Approximation

Obviously, a close approximation of the head loss in any regular grid system could be obtained with a minimum of effort by equating the head loss in this first section of pipe to the proper factor from Fig. 4. In the above case, for example, if the head loss in 500 ft. of 8" pipe carrying 1000 gpm is 14.2 ft., then a grid of 8" pipe on 500 ft. centers would deliver 4000 gpm through a single hydrant with a pressure drop of $\frac{14.2}{0.75}$ = 19.0 ft. Since the accuracy obtained would equal that of the basic assumptions used in more detailed methods of computation, it would be advantageous to use Fig. 4 for pipe sizes or lengths not included in Fig. 2 instead of the Hardy Cross method.

Since pipe losses vary directly with pipe lengths, Fig. 4 can be used also for grids with any spacing so long as the pipes are equidistant in both directions. For example, the head losses to be expected in a 10" grid, with pipes 300 ft. on centers, would be 3/5 of the values given in Fig. 2. Or with flow from a single hydrant, from Fig. 4, the total loss in the grid would be 4/3 of the loss in 300 ft. of 10" pipe whose discharge was one-fourth of the total fire draft.

Fig. 4 also shows how rapidly the head loss with flow from one, two and four hydrants decreases as the distance from the hydrant increases. In all computations, it has been assumed that the head losses beyond a point 2500 feet (or five city blocks) distant from the hydrant are so small as to be negligible. The error introduced by this assumption can be easily determined from Fig. 4 for any given case. For example, the loss in a distance of 2500 ft. is 98.5% of that in 3125 ft., even though the 2500 ft. is only 80% of the total distance.

The data given in Figs. 2 and 4 check with reasonable closeness the curves in the A. W. W. A. Manual mentioned above, indicating that this earlier work was accurate even though less satisfactory methods of computation were then available than at present.

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(Part III)

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The larger part of the pressure drop naturally occurs in the section of pipe nearest the fire hydrant because of the relatively greater discharge in this pipe. In fact, for flow at a single hydrant an average of 75.0% of the total pressure drop occurs in this section of the pipe for all diameters and for 500 ft. pipe spacing. Fig. 4 gives the head losses at varying distances from the point of draft and for discharges from 1, 2 and 4 hydrants.

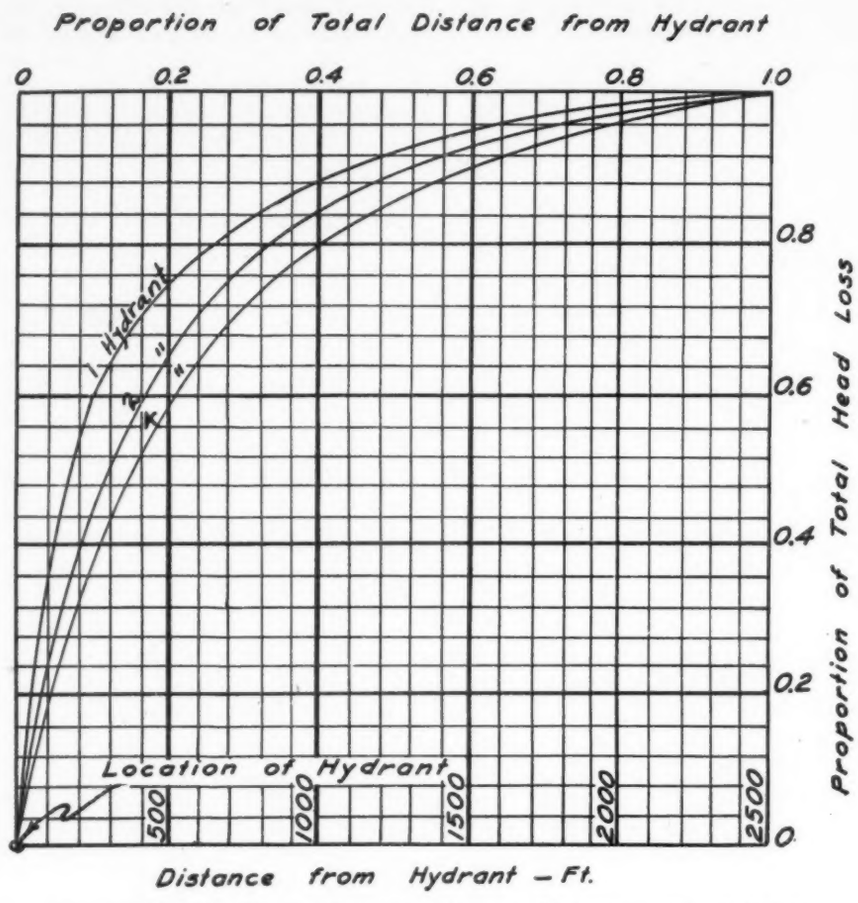

Fig. 4.—Relationship of Pressure Losses to Distances from Hydrants

Obtaining a Close Approximation

Obviously, a close approximation of the head loss in any regular grid system could be obtained with a minimum of effort by equating the head loss in this first section of pipe to the proper factor from Fig. 4. In the above case, for example, if the head loss in 500 ft. of 8″ pipe carrying 1000 gpm is 14.2 ft., then a grid of 8″ pipe on 500 ft. centers would deliver 4000 gpm through a single hydrant with a pressure drop of $\frac{14.2}{0.75} = 19.0$ ft. Since the accuracy obtained would equal that of the basic assumptions used in more detailed methods of computation, it would be advantageous to use Fig. 4 for pipe sizes or lengths not included in Fig. 2 instead of the Hardy Cross method.

Since pipe losses vary directly with pipe lengths, Fig. 4 can be used also for grids with any spacing so long as the pipes are equidistant in both directions. For example, the head losses to be expected in a 10″ grid, with pipes 300 ft. on centers, would be 3/5 of the values given in Fig. 2. Or with flow from a single hydrant, from Fig. 4, the total loss in the grid would be 4/3 of the loss in 300 ft. of 10″ pipe whose discharge was one-fourth of the total fire draft.

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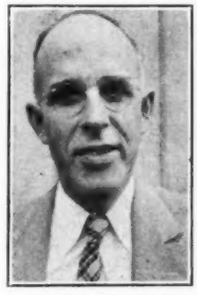

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* Research Chemist, The Chlorine Institute, Inc., New York City.

exhaustive paper, which will prove valuable as a source of reference data on this subject, he described these chemical and physical changes and illustrated them with a series of slides. Analyses made twice weekly on samples of the Wanaque reservoir water prove the most important factors to be the spring and fall overturns and the stagnation periods of summer and winter. Some of the characteristic variations which were illustrated: dissolved oxygen, carbon dioxide, hydrogen sulfide, iron and manganese, color bleaching, and algae changes. A reservoir was defined as "aged" when the water delivered by it ceases to improve further in respect to chemical and physical qualities.

ARTHUR H. PRATT, Cons. Engr., Newark, N. J., associated with the project since its inception, stated that the Wanaque Reservoir was not stripped of growth except in portions where this was incidental to other work. The value of providing outlets at three levels—upper, middle and lower—has been proved in operation.

ROBERT SPURR WESTON, Cons. Engr., Boston, Mass., pointed out that stripping is always considered desirable. The color of surface water is not always in true solution and is influenced by iron and manganese contents. Manganese flocculates less effectively than does iron, thus has less influence on color and turbidity changes with aging. As the years pass, reservoirs become less affected by the soil and more affected by deposits within the reservoir.

New Chlorine Test Described

"An Iodide Technic for the Colorimetric Determination of Chlorine In Water", by F. W. GILCREAS, San. Chemist, State Dept. of Health, Albany, N. Y.

Interfering substances, such as manganese in stored surface waters or ground waters and nitrites in swimming pool waters, seriously affect the accuracy of the standard ortho-tolidin test for residual chlorine. Misleading results may also be obtained when using the starch iodid test under acid conditions, if these substances are present. Considerable research has shown, however, that reacting liberated iodine with alpha-naphtha flavon as the indicator produces a color which varies in proportion to the amount of actual residual chlorine present. When pH of the water is above 6.7 there is no interference introduced by the presence of manganese or nitrites. If the water is first buffered to pH 9.0 before adding the reagents, the method becomes thoroughly reliable. In practice, a tablet form of the buffer-iodide mixture is dissolved in the water to be tested and the flavon

M. M. Braidech
Cleveland, Ohio
Elected to Executive Committee of the Division

Geo. D. Norcom
New York, N. Y.
Chairman of Committee on Water Quality & Treatment

indicator is then added. After standing for three minutes for full color development, the amount of residual chlorine present is determined by comparison with standard color solutions. Only when under 10°F. is temperature of the water an important consideration.

GEORGE E. WILLCOMB, Supervising Chemist, Div. of Water and Sewage, Albany, N. Y., in discussing the above paper, cited comparisons of results of ortho-tolidin tests with those using alpha naphtha flavon. At the Albany Filtration Plant, manganese content of the water varies from 0.1 p.p.m. in winter to 3.5 p.p.m. in the fall and this new residual chlorine test has proven dependable through three years of use.

Water Conditioning and Coagulation

"Fundamentals of Water Pretreatment", by FRANK BACHMAN, Director of San. Sales, The Dorr Co., New York, N. Y.

In orderly sequence, Mr. Bachman discussed the various treatment processes and treatment mechanisms which may be applied to water up to the point of filtration. By giving the specific reason for and the relative value of each procedure, he presented considerable useful information. Presettling of raw water, with or without a coagulant, has been found beneficial with some waters and is practiced at Louisville, Cincinnati, St. Louis, New Orleans. This treatment frequently results in reduced chemical cost, uniformly low turbidity, and less frequent cleaning of coagulating basins. Several desirable features of initial flash mixing were recounted.

Although the speed of agitation required for flocculation is lower than that used for initial mixing, it should be as high as can be applied without breaking the floc. In the mechanical flocculator, horizontal paddles are best rotated with a peripheral speed of 0.6 to 1.8 feet per second, and there exists a definite relation between chemical dosage and flocculating time. Return of settled sludge may result in reaching the same final turbidity in a shorter period of time. Addition of turbidity or use of an increased alum dose may produce a heavier floc which will be more effective for such purposes as the removal of algae from clear water. In treating some waters perhaps one-half of the size and detention time of settling basins may prove adequate if continuous sludge removal equipment is provided.

ROBERT W. FURMAN, Supt. of Water, Toledo, Ohio, discussed the improvements due to proper design of mixing and flocculating equipment at Toledo. It appears that a number of filtration plants in northern Ohio must treat water which contains turbidity consisting of suspended clay covered with an oil film. Proper flocculating equipment, best operated at a peripheral speed of 1.0 foot per second, has resulted in a 15 to 25% saving in coagulant when treating waters with turbidity ranging from 500 to 1000 p.p.m.

"Experiences With the Coagulation of Soft, Colored Water by Ferric Sulfate", by GEO. E. WILLCOMB, Supervising Chemist, Div. of Water & Sewage, Albany, N. Y.

Several advantages, such as the lower temperature and freedom from algae tastes, have made it desirable to draw bottom water from the Albany reservoir for filtration. During the summer months, high iron and manganese concentrations exist and are difficult to remove by coagulation with alum and subsequent filtration. Turbidity of the water offers no problem, but color removal using alum alone takes place most satisfactorily at about pH 6.7 at which point iron and manganese remain soluble.

Ferrous sulphate (copperas) was applied as the coagulant in conjunction with lime to produce a pH of 9.5, for ten weeks during the late summer of 1937. A 99% removal of manganese was effected but an iron

content of 0.12 p.p.m. appeared in the filter effluent and may have accounted for a slightly bitter taste which developed in the finished water. In 1938 "Ferrisul" (ferric sulphate) was used as the iron salt (with lime) for a period of five months of summer operation. Results show reduction of color to 4 p.p.m., of manganese to 0.02 p.p.m., and of iron to 0.03 p.p.m. Coagulation was interfered with when the fall overturn of the reservoir occurred and alum treatment was resumed. Removal by sedimentation basins proved to be low, residual iron and manganese having coated filter sand to the extent of 47 pounds per ton of sand. After winter coagulation with alum, about half of this sand coating still remained. The residual coating accomplished a 65% removal of manganese even with alum coagulation alone, and the effluent was satisfactory when manganese content of the raw water did not exceed 0.75 p.p.m. Mr. Willcomb concludes that coagulation during the summer months with ferric iron coagulant is the preferable treatment.

A. H. ULLRICH, Purification Engineer, Fort Smith, Ark., discussed this paper and referred to experiences at Fort Smith, where turbidities range from 2 to 410 p.p.m., but where there is no manganese problem. Using ferric sulfate, a reduction in coagulation costs is accomplished, but the pH of 8.5 carried in the finished water caused the zinc of galvanized iron piping to be attacked. He pointed out that since the finished water left the Albany plant at pH 8.7 in 1937 (when using copperas) and at pH 8.3 in 1938 (when using ferric sulfate) such might account for the difference in taste.

Softening in Upward Flow Basins

"Illinois' Experiences in Lime Softening with Short Time Upward Flow Clarification," by C. W. KLASSEN, Chief San. Engr., and H. A. SPAFFORD, Asst. San. Engr., State Dept. Health, Springfield, Ill.

The Junior author described construction and operation features of a number of "Precipitator" and "Accelerator" types of softening plants installed in Illinois. Rates even higher than the one hour mixing and settling period, with 3.25 gal. sq. ft. min. radial flow (at present the maximum rate), may be found possible. A crystalline form of $CaCO_3$ may occur in the slurry under exceptional conditions, but is not desirable since it may overload the clarifying equipment. Ordinarily solids amount to 0.5 to 2.0% (by weight) in the slurry.

H. W. Streeter, U.S.P.H.S., Cincinnati, Ohio; F. R. Schmelkes, W. & T. Co., Newark, N. J.; E. Sherman Chase, Cons. Engr., Boston, Mass. (Chmn. Committee on Cross Connection)

Series treatment appears desirable with certain waters, using the second basin for stabilization and the addition of the coagulant. High rate operation requires more critical regard of chemical dosage and may prove difficult to use with flashy waters. The basic principles of such treatment have now been demonstrated in operation, and each new plant profits by earlier experience.

"Performance of Upward Flow Basins at St. Petersburg, Florida," by ROBERT W. SAWYER, Asst. to MALCOLM PIRNIE, Cons. Engr., New York, N. Y.

Welded steel cylindrical tanks have been economically employed in the construction of an unusual 12 m.g.d. capacity plant to soften ground water. By means of slides, the author described the tank construction and arrangement of various units such as mixing, coagulation, settling, and filtration tanks. Operation provides split treatment, involving lime softening of 70% of the supply and iron coagulation (ferric sulfate) of the remaining 30%.

Water is mixed with chemicals both in separate spiral flow tanks and in the central down-flow influent wells of the sedimentation tanks providing up-flow clarification. Distributing pipes extend radially from the bottom of influent wells and water enters the tank bottom through a series of distributing pipes and orifices. Treated water rises at a rate of 1 to 1⅛ inches per minute, which allows a detention time of 3.33 hours. The accumulated sludge slurry, suspended in the lower portion of the tank, provides effective contact material. About one minute is required every three days to draw off excess sludge through the influent distribution pipes. Methods of storing and feeding chemicals as well as chemical and operating costs were touched upon.

In a discussion of these two papers, W. A. CRAMER, Asst. Engr., State Health Department, of Missouri, stated that a similar method of sedimentation had been patented about 1900.

S. B. APPLEBAUM, The Permutit Co., New York, presented detailed data on the operation of a "Precipitator" unit which operates in parallel with a conventional mixing and settling basin, both treating Mississippi River water. The former produces superior results despite the fact that it is only one-third the size of the older unit. He listed advantages found in a variety of other installations, noting that rates should be conservative but need not be constant. Series operation is desirable when treating magnesium waters.

A. S. BEHRMAN, International Filter Co., Chicago, Ill., discussed the points of contrast between the "Accelator" and the St. Petersburg upward-flow basins. The latter have no forced circulation of chemically treated water with the sludge slurry, but only a rising contact. Also there is no line of demarkation between the zone of circulating slurry and zone of clarification in the latter installation.

MALCOLM PIRNIE, Cons. Engr., New York, N. Y., explained that no claim had been made that treatment by the "Accelator" and the St. Petersburg upflow tanks is similar, but noted that the latter is also a sludge contact treatment process which has proven to be economical and effective.

[As a matter of interest some of the very earliest commercial softening plants were constructed vertically, providing deep up-flow clarification, with center down take in let, and up-flow filtration through excelsior beds.—Ed.]

Symposium on Water Quality

The entire final half-day session of the Purification Division was given over to a series of papers on the subject of water quality, which were arranged by the "Committee on the Coordination of Methods of Water Treatment and Laboratory Control."

GEORGE D. NORCOM, Cons. Engr. and Chemist, New York, as chairman of the committee, presented a general statement of the subject. He reviewed the facts concerning outbreaks of gastroenteritis at Milwaukee, of typhoid at Minneapolis, and of other similar outbreaks which have focused attention upon the pos-

sibility that such have been water-borne. More rigid standards of bacterial quality have already been adopted in Wisconsin by the State Dept. of Health, and an article by JOHN R. BAYLIS, of Chicago (WATER WORKS & SEWERAGE, March, 1939) proposes a yet higher bacterial quality. Since the adequacy of present standards is under question, and since the work of the committee is in part concerned with the development of acceptable standards of quality and treatment, a review of the existing situation and an opportunity for open discussion had appeared desirable, accounting for the symposium.

"Standards of Raw and Treated Water Quality," by H. W. STREETER, Senior San. Engr., U. S. Public Health Service, Cincinnati, Ohio.

The U. S. Treasury Department standards of water quality, adopted in 1925, were developed for the examination of waters used in interstate traffic. These standards were not intended for general application. However, since they have been widely adopted in this connection it is important, said Mr. Streeter, to realize that the bacteriological standards were not intended to be used alone. Such items as the sanitary survey, chemical and physical tests, reliability of water treatment processes, etc., must all be taken into consideration in appraising the quality of potable waters.

Probably 75% of all water supplies meet the general standards and perhaps 90% meet the bacterial standards specified by the Treasury Department for its own use. Thus, while there is a correlation between the delivery of water which meets these standards and freedom from typhoid fever, there is no relation between these standards and insurance that water of such quality is incapable of transmitting intestinal diseases. The 1930-31 epidemics of gastro-enteritis, commented Mr. Streeter, were apparently caused by water which did meet present bacteriological standards and probably both the Minneapolis and Milwaukee epidemics were waterborne despite records which indicate satisfactory bacterial quality.

He noted that the only existing official standards of water quality are those of the International Joint Commission for raw water. These specify an average Coli Index of less than 500 per 100 cc of water, in order that the water may be so treated (with 99.6% efficiency) as

Frank Bachman, The Dorr Company, New York; F. W. Gilcreas, N. Y. Dept. of Health, Albany; S. B. Behrman, Int'l. Filter Co., Chicago

to produce an effluent meeting the original Treasury Department standard—a Coli Index of 2 per 100 cc. Mr. Streeter explained that the proposed increases in the bacteriological standards for finished water would necessitate correspondingly higher standards of raw water quality. Thus, many existing sources of supply would be either unacceptable under the new standard or the degree of treatment must be increased by the construction of more extensive plant structures, in order to permit continued use of some supplies. In his opinion, entire dependence should not be placed upon a rigid bacteriological standard of quality, but a broader application of present principles should be made.

"Water-Borne Gastroenteritis", by C. R. COX, Chief, Bureau of Water Supply, State Dept. of Health, Albany, N. Y.

Reduction of typhoid fever, Mr. Cox pointed out, has led to a false sense of security. Our principles of treatment and testing are not at fault but there are several other water-borne diseases whose significance has recently been recognized. He reviewed the extent and nature of gastroenteritis cases which have been reported in the United States and discussed more extensively the factual information which has been collected with reference to New York State epidemics. Often dysentery cases are not reported by the health offices and are only learned of when typhoid fever is reported. Extensive measures are now taken in New York State to gather information during the occurrence of such cases; apparently 24 outbreaks in 1937 and 21 outbreaks in 1938 were water-borne epidemics, though only two of the latter were on public water supplies.

Either temporary pollution of untreated sources or temporary failure of treatment plants have been found responsible for all water-borne outbreaks, upon which complete information is available, in N. Y. State. Exceptional conditions such as serious pollution due to drouths, chemical pollution and organic decomposition (which may result in the presence of specific irritants) were contrasted with bacilliary dysentery due to pathogenic bacteria. Outside of such unusual conditions, which are not typical of normal supplies, it was his opinion that present bacteriological standards and methods of water treatment are adequate to insure freedom from water-borne gastroenteritis.

"Bacteria from Chlorinated Waters", by PROFESSOR MAX LEVINE, J. M. COBLENTZ, and PHILIP CARPENTER, Iowa State College, Ames, Iowa.

In accordance with requests from the Coordinating Committee, ninety-seven cities have sent a total of 162 cultures isolated from chlorinated water, to Prof. Levine for identification. His report described the investigations to determine whether such cultures are really chlorine resistant or whether they have merely been protected from the action of chlorine by clumping or other causes.

There were 282 strains of organisms isolated in the study: 196 proved to be members of the Coli-Aerogenes group (of these 65% were slow lactose fermenters), 5 were Shigeli (dysentery), 4 were Salmonella, and 8 were Eberthella. Slow lactose fermenting types are more prevalent in the samples taken during the summer and apparently are associated with soil wash. Chlorine resistance is not typical of the coli form organisms and apparent chlorine resistance cannot be supported until the study is extended to cover the factors of bacterial clumping and protection by organic matter. Further investigation will be in the direction of improving routine bacteriological methods to yield more conclusive information.

"Factors Affecting the Efficiency of Chlorination", by DR. F. C. SCHMELKES, ELIZABETH S. HORNING, and GEO. A. CAMPBELL, Research Laboratory, Wallace & Tiernan Co., Newark, N. J.

After describing the inherent limitations of the ortho-tolidin test for residual chlorine, Dr. Schmelkes pointed out that even if a chlorine residual is accurately measured, it does not indicate the germicidal effectiveness of that dose. This is because such factors as pH, alkalinity, and ammonia, all affect the oxidation potential and, thereby, the powers of disinfection. Development of equipment to measure oxidation potential. first of chlorinated water then of

(1) Jas. H. Kennon, Engr.-Mgr. Water Dep't., Pittsburgh, Pa.; (2) Jule H. Cotfey, Vice-Pres., Pomona Pump Co., California; (3) W. "Pete" Cox, Gen'l. Sales Mgr., McWane Pipe, Birmingham; (4) C. M. McCord, Gen'l. Sup't., Water Dep't., Memphis; (5) H. V. Pedersen, Sup't., Water Works, Marshalltown, Ia.; (6) C. J. Canton, Badger Meter Co., Baltimore, Md.; (7) I. M. Glace, Consulting Engr., Harrisburg, Pa.; (8) Alan W. Ross, Vice-Pres., Layne Company of New York.

the same water after dechlorination gives an accurate determination of potential difference, and thus of the disinfecting ability of that chlorine dose. Variations in pH, ammonia, nitrites, and manganese do not interfere with oxidation potential measurement.

Various forms of such equipment have been devised and are suitable for different purposes. Experimental installations of this device on plant-scale operation has shown that more uniform disinfection can be obtained and at the same time results in savings in the chlorine dose required. Many laboratory studies were described and illustrated to show the differences in bacterial kill by chlorine alone, by chlorine-ammonia, and by preformed chloramine, under conditions of identical residuals, as measured with ortho-tolidin.

Discussion

GEORGE E. SCHAUT, Chief Chemist, Bureau of Water, Philadelphia, stressed the importance of more extensive chemical tests on raw water. He believed present bacteriological standards to be adequate but favored increased recognition of the effect of chemical pollution by decomposing vegetation or industry.

H. W. STREETER, agreed with the importance of chemical tests in determining water quality and wondered if dead organisms might have a possible effect.

E. SHERMAN CHASE, Cons. Engr., Metcalf & Eddy, Boston, Mass., discussed the possibility of temporary pollution, or pollution via cross connections, which might not be apparent in routine water examinations. There are still 22 states which have no regulations governing cross connections, and yet this factor may be of great public health significance.

DR. F. S. SCHMELKES commented on the possibility of disease production from toxins when chlorination had destroyed bacteria. He stated that toxins are not active in an oxidizing solution and that they are unlikely to be of importance when residual chlorine is present.

*Papers Before the Joint Session of the Plant Management and Purification Divisions**

(Vice President N. J. Howard, Presiding)

"Further Notes on C. I. Pipe Corrosion and Its Control", by THOMAS H. WIGGIN, Cons. Engr., Federal Water Service Corporation, New York City.

Colonel Wiggin's "Further Notes" constituted a brief resume of the major disclosures contained in a paper of note by himself and George D. Norcom which was presented before the 1938 Convention in New Orleans. (The digest covering this illuminating paper is to be found in "WATER WORKS AND SEWERAGE" for June, 1938, on page 614. The complete paper is to be found in the A.W.W.A. Journal for August, 1938.)

The findings reported in the paper by Messrs. Wiggin and Norcom constitute the results of a careful study of representative water supply systems in order to determine the effectiveness of water treatment with lime for the purpose of controlling corrosion and tuberculation of trunk mains and distribution pipes. It reveals the rate of depreciation in the coefficient values "C" for mains in service before and during corrective treatment of the water; the relative efficacy of the treatments in suppressing tuberculation rates, loss of pressure, and reduction of operating costs represented by power savings in pumping. These joint studies of engineer and chemist represents the most thorough known investigation of the value of main cleaning followed by factual observations into the effectiveness and/or deficiencies of corrective treatment by pH adjustment to maintain low friction values produced by main cleanings.

Studies reported on in 1938 were confined to a filtered water supply of medium hardness—that from Lake Erie. Trends of the "C" values, inspection of mains and water analyses revealed the lime treatment to be completely effective in correcting rusty water complaints, but in a much lesser degree effective in holding down depreciation of "C" values in cleaned mains. The present addenda to Col. Wiggin's progress studies concerns a filtered soft water (hardness of 35 to 40 p.p.m.) serving Westchester County, N. Y. Based on findings the softer water, with lime treatment, had given a tuberculating history not worse than the harder Lake Erie water. Cleanings of a 16-in. main had boosted the "C" value to 132, and then followed a drop to C=99.4 after 2 years; in another instance, "C" of 130 having dropped to 98.5 after 1 year.

In the conclusions reached there had been no change, as the outcome studies on the softer supply, from those presented in the 1938 paper. Amongst these was the demonstrated value of lime treatment for red water troubles, but the continued justification and economic benefits from routine cleanings of supply mains to return "C" values to 130, or thereabouts, at the beginning of the peak demand summer season. In brief, lime treatment of the water had not proved a sufficient retardent of tuberculation to justify let-up in watching the trend of friction and pumping costs, and systematic cleaning operations for operating economy.

By the same token lime treatment alone has not been proved a substitute for the adoption of protective pipe linings or the use of pipes of non-tuberculating materials. [By like reasoning, one may be certain that chokage of service pipes of unprotected steel may be suppressed only to a limited degree by moderate lime treatment, and that more resistant materials continue to be justified for service lines and household piping where the water is not

(* NOTE—The digests covering the papers presented in the Joint Session were not prepared by Mr. Faber.—Ed.)

throughout the system a depositing water by nature, or rendered so by treatment selected on the basis of test demonstrations.—Ed.]

Mr. Wiggin, in commenting on vacuum degassification for tuberculation suppression, believed it particularly feasible for closed systems. The desirability of aeration to reduce carbon dioxide content of ground waters, in attempts to reduce lime requirement in pH adjustment, he questioned. His grounds were that the oxygen added to the water might well be regarded more seriously than the value of the lime saved. (It may be added, that the usually soft waters from wells high in CO_2 need the greater hardening which the natural lime demand brings about. A combination for possible maximum economy may well be partial CO_2 removal by low cost partial degassification, plus lime treatment to convert the residual CO_2 to normal carbonate, producing minimum total hardness increase for maximum protection.—Ed)

"Correlation Between Carbon Dioxide and Mineral Content of Waters—and Observed Corrosivity" by DR. WILLEM RUDOLFS and T. T. WONG, New Jersey Agr. Exptl. Station, New Brunswick, N. J.

This paper, presented in abstract by Dr. Rudolfs, constitutes a report of findings from exact studies of corrosion effects, particularly directed toward ground waters. The paper is replete with information of a basic nature, including the checking of theories. Of such papers, a digest is inadequate and, although some of the high spots may be covered in these paragraphs, nothing less than a careful reading and study of the paper when it appears in the A.W.W.A. Journal will bring to the reader its real value.

The New Jersey studies revealed that evaluation of corrosivity of waters by studying the pick-up of iron content, which applies to surface waters with fair satisfaction, does not apply in the case of well waters. Attempts to correlate corrosion effects and constituents of waters proved a failure when employing synthetically compounded waters. Proof was available that the resultant *net* effect of the various *combinations* of negative anions, positive cations, and oxygen was the only dependable effect—in which not less than three factors are involved in the simplest combination effects.

Somewhat surprising was the revelation that well waters of constant dissolved oxygen and carbon dioxide content became increasingly corrosive with increasing bicarbonate alkalinity content, the corrosivity curve mounting as a straight line up to 100 p.p.m. bicarbonate increase. With surface waters just the reverse was observed, the curve descending with bicarbonate increase. Concerning carbon dioxide effects, the corrosivity curves flatten perceptably with increasing carbon dioxide content. The relationship of dissolved oxygen and CO_2 effects was found very similar for both surface and ground waters.

Tom Cole, Sup't. Filtration, Poughkeepsie, N. Y. (Operates America's oldest filter plant); John Harrington, Chief Engr., W. Va., Dep't. of Health, Charleston; Charlie Young, Distr. Engr., Penn., Dep't. of Health, Meadville

According to theory, increasing anion (chloride, sulphate, HCO_3, etc.) concentrations increased corrosivity, whereas increasing cations (calcium, magnesium, sodium, etc.) suppresses corrosivity. The New Jersey studies failed to reveal that the theory holds in all cases, the boost in sulphate content failing to have any serious effect.

The paper contains a worthy discussion of the "Mechanism of Corrosion" and presents several points which may lead to a better understanding of corrosion factors and advances in corrosion suppression.

CARL J. LAUTER, Supt., Dalecarlia Filters, Washington, D. C., pointed out that Dr. Rudolf's observations were in line with Washington experience, wherein effluent from slow sand filters could carry a higher free CO_2 content without producing red-water troubles than was the case with the alum coagulated rapid filter effluent. While, the latter required lime sufficient to produce a finished water saturated in respect to calcium carbonate, the slow filter effluent did not. He had found absolutely no correlation between conductivity values (total ion content per unit volume) and corrosivity of Washington water.

"Threshold-Treatment as Applied in Scale and Corrosion Control on Municipal Systems" by OWEN RICE and G. B. HATCH, Hall Laboratories, Inc., Pittsburgh, Pa.

In this magazine several articles on the new **"Threshold-Treatment"** of softened waters to suppress troublesome after deposits of calcium carbonate scale in water piping systems have appeared in recent months. For two of these we refer our readers to the January, 1939, issue of WATER WORKS & SEWERAGE (p. 10, C. P. Hoover and Owen Rice), and the February, 1939, issue (H. O. Hartung, p. 56.) These two articles give an excellent description of the new **"Threshold Treatment,"** which involves applications of minor quantities of hexametaphosphate (0.5 to 2.p.p.m.) to prevent calcium carbonate depositions near the point of lime treatment and, by delaying precipitation effects, cause its more even deposition throughout the system and sustained pH of the water. By the same token the treatment suppresses choking scale formations in hot water systems.

All of this was reviewed by Mr. Rice, who explained that the material which his company produces under the trade name of **"Calgon"** is a true hexametaphosphate produced by proper proportioning of soda ash (Na_2CO_3) and phosphoric acid (H_3PO_4) in a mixture which is fused in producing a highly soluble "glass." The solution he explained is harmless, internally as well as externally.

Following discussion of the effects of **"Calgon"** in apparently "boxing out" the molecular "tackles and ends" which form precipitates of calcium or metallic salts, and methods of evaluating the effects secured —one being by use of the "Enslow Stability and Corrosivity Indicator" (WATER WORKS & SEWERAGE, Mar. 1939, and July 1939), Mr. Rice disclosed more recent observations revealing the efficacy of **"Threshold-Treatment"** in suppressing corrosion at pH values between 6 and 11. (Experiences and results cited were supported by continuous demonstrations of corrosion control, as well as scale control, at the booth of his company). The rust formation, if any, in **"Calgon"** treated water he pointed out was of darker color and considerably more dense, and thereby more protective than the ordinary spongy hydrated oxides of irons. Interesting was the demonstration with steel wool which aerated **"Calgon"** treated water failed to rust during the period of the convention. This, Mr. Rice explained, to be due to an apparent saturation of the metal surface with hexametaphosphate or some part thereof. He stated

that the phosphate-plating effect gradually wore off after discontinuance of treatment; likewise, was observed to require several days in its reestablishment following recommencement of treatment, the time being proportional to the concentration of the salt. Mr. Rice pointed out that their attention had been directed to the corrosion inhibiting effect by experiences in which old hard scale had been distintegrated, leaving bare metal tubes which all concerned expected would be corroded and pitted unless some protection was returned to the surfaces.

Mr. Rice's paper received probably the greatest amount of discussion of any single paper presented during the entire convention. Replying to questions, Mr. Rice said that **"Calgon"** retards the rate of disappearance of zinc from galvanized pipes by about half, but it eventually goes. To him zinc was too temporary to deserve emphasis, in any event. The phosphate is apparently adsorbed to a greater or lesser degree by all metals or oxides of metals. It prevents colloidal iron from precipitating similarly to its effect on colloidal calcium carbonate—1 p.p.m. **"Calgon"** holding up 0.5 p.p.m. iron. In pipe systems the stretching or spreading of protective carbonate or phosphate films (or both), with high or low pH values, seemed to be the most important attributes of the new **"Threshold-Treatment."**

JOHN R. BAYLIS (Chicago), pointing to the importance of film protection said that if the original protective film could in turn be protected there was no need for worry about corrosion. Contrary to the belief of some, he had always advocated the carbonate film as a deposit to protect the pipe manufacturers protective film, such as the tar coat, etc., rather than a sufficient protection to bare steel or iron. He was impressed with the potentialities of phosphate treatment in advancing the possibilities of uniform film deposition and protection throughout the system.

JAMES E. GIBSON, (Charleston, S. C.), recognized as the pioneering fighter for pipes with protective linings, and now cement-lining parts of his distribution system in place by the Tate Process, remarked that he was no believer in "doctoring" the water supply to stop tuberculation. Proof is, he had tried high pH treatment with ill effects on some Charleston industries.

S. T. POWELL (Baltimore, Md.) said that high pH treatment for corrosion control had created damage in dying operations, to zeolite beds, and in other directions. While caution was advocated in following hobby riders too precipitately, the observed effects of phosphate treatment in industrial water supply had

H. A. Spafford, Ass't. Engr., Ill. Dep't. of Health, Springfield; F. H. Whitley, N. Y. University, New York; Dan Rupp, Sup't. Filtr. & Sewerage Treatment, Topeka, Kan.

been nothing short of remarkable. He wondered if the suppressed carbonate precipitate, otherwise depositing in the mains, might not now come out more pronouncedly in the household hot water systems. That might or might not be a good thing, and deserved some inquiry in considering long range effects.

CHAS. SPAULDING (Springfield, Ill.), where the pH of the softened water always ranges between 9.6 and 10, has even so experienced corrosion troubles along with depositions of soft carbonate film. In Springfield, corrosion peaks occur in both summer and winter, without correlation to dissolved oxygen content. For the past year tests have been under way to determine on a corrective procedure, and these now included **"Calgon"** treatment.

Super-Chlorination Progress

"Super-Chlorination Practices in North America" by HARRY A. FABER, Research Chemist, The Chlorine Institute, New York City.

Mr. Faber, in an outstandingly well prepared and presented paper, reviewed the history and accomplishments of water super-chlorination and dechlorination, the notable example standing the test of time being that of Toronto, for which N. J. Howard deserves high credit for the preparatory research involved and the bold but successful enterprise.

Initiated as a means of destroying taste producing substances with the excess chlorine added above the nominal demand, Mr. Faber pointed out the added significance which high-chlorination had taken on since the advent of recurring intestinal disturbances which were throwing increasing suspicion (even though possibly not justified in the majority of cases) on water quality and the present yard-sticks employed in laboratory control.

The paper outlined the three methods of super and de-chlorination. These involve feeding of sulphur dioxide gas, through machines similar to chlorinators, in ratios of 0.9 lbs. SO_2 to 1 lb. of residual chlorine (Toronto). The use of sodium bisulphite (solution) in ratio of 1.6 lbs. to 1 lb. of residual (Glencoe, Ill.). The use of granular carbon contact units in which 1 lb. carbon removes continuously 11.8 times its weight of residual chlorine (Culver City, Calif., etc.). Another scheme, such as is employed at Tyler, Texas, involves chlorine dissipation in open reservoirs by sunlight and 4 hr. contact, where 1 p.p.m. residual (2 to 7 p.p.m. dosage) is thus reduced to between 0.1 and 0.3 p.p.m. at the taps. Still another method was that of converting super-chlorination residuals (0.5 or under) to chloramines by final ammoniation. In several food and beverage plants all tastes are being destroyed by 3 to 4 p.p.m. *residual* followed by carbon filters at 3 g.p.m. rates per sq. ft. Mr. Faber, by tabulated data then revealed the methods and dosages employed by 10 municipal plants now employing super and de-chlorination successfully.

The important question discussed by Mr. Faber was: "What constitutes super-chlorination?" This he answered by exhibiting chlorine demand curves, revealing in a clear manner that many waters showed increasing residuals with increasing dosages up to a point and, thereafter, as the dosage increased the residual actually decreased, or else did not mount until a decided increase was applied. Here (at the break point), he explained, super-chlorination really begins without regard for what the total dosage may be to reach the point. Such point moves up or down the scale as the buffering value and organic content of the water changes. At one season (Tyler, Texas for example) it may be at 2 p.p.m. and another at 7 p.p.m.—both dosages giving 1 p.p.m., residual, and leaving but .1 to .3 residual after 4 hours of contact. This point of dip or break in the residual curve, Mr. Faber explained as the oxidation point. All residuals at lesser dosage to be the chloridizing residuals, in reality substitution products yielding chlorine upon acidification with orthotolidin solution. These same products (re-

(1) S. A. Canariis, Engr., Pomona Pump Co., Pittsburgh and Ora C. Ayliffe, Sup't. Filtration, Fargo, N. D.; (2) John McKague, National Meter Co., N. Y. City and "Cap" Ned Herbert, Sup't. Water, Norfolk, Va.; (3) J. P. B. Maylar, Engr. and Boyd A. Bennett, President Northeastern Water & Elec. Co., New York City; (4) M. W. Obermdorfer, Lynchburg Fdy. Co., Lynchburg, Va., W. B. Harman, Auditor, Water Dep't., Newport News, Va., and A. P. Breeden, Auditor, Water Dept., Norfolk, Va.; (5) Chas. P. Abraham, Sup't. of Water, Lancaster, Pa.; (6) "Reggie" Hayes, Hydraulic Development Co., Boston and H. J. Helberg, Hersey Meter Co., Boston.

siduals up to 1 p.p.m. perhaps) had been responsible for serious indictment of Mr. Howard's Toronto work when less bold men had stopped short of the oxidation mark. On the other hand, Richmond, Va., with prechlorination, had gone over without regard for dosage to maintain not less than 1 p.p.m. residual out in the basins.

Mr. Faber then described the true test for chlorine dosages if superchlorination was to become a practicable dependable procedure. The scheme involved jar tests similar to those in coagulation control, with increasing chlorine dosages being applied to pass the dip zone of the residual curve. The oxidizing dosage would be that on the steep incline of the curve to the right of the dip (or levelling off zone) between chlorination and oxidation. A study of tastes of the water in the jars with and without de-chlorination reveals the truth about super-chlorination.

In reply to questions, Mr. Faber stated that a filtered water of 40 threshold odor value had been very successfully destroyed with superchlorination dosages but was vile with less than sufficiency.

CHAS. R. COX (N. Y. Dept. of Health) commented that with chlorine in ton containers the dosages involved in super-chlorination would not prove unreasonable in cost. He felt that the large figures in dosages had frightened operators unnecessarily.

R. G. YAXLEY (Supt. of Water, Waterford, N. Y.) said that his supply (Hudson River) was now being chlorinated to the highest degree in history of the plant and the best effluent ever produced was his reward. The procedure involved a raw water dosage of 7.3 p.p.m.; 2 hrs. basin contact; 3 p.p.m. residual at the filters for safety, such being reduced by the filters to between 0.2 and .5 p.p.m. in the final effluent—all without taste complaints. (We can not be positive but believe that Mr. Yaxley adds ammonia to the water leaving the plant.—Ed.)

Carbonaceous Zeolites

"Recent Experiences with Carbonaceous Zeolites" by S. B. APPLEBAUM, Vice-President, The Permutit Co., New York City.

Mr. Applebaum's paper constituted a brief summary of experiences with the new carbonaceous zeolites in producing process and boiler waters of as low degree of hardness as desired and the nearest approach to distilled water that has ever been produced by any practical method of treatment on an economical scale. These new zeolites, known as hydrogen zeolites, he explained to be essentially sulphonated coal. They have proved especially interesting because of their low silica content and their ability to remove sodium along with calcium, magnesium, etc., when regeneration is effected with sulphuric acid instead of brine. Thereby, in series with sodium zeolite, the acid regenerated (hydrogen) zeolite converts the sodium bicarbonate of the ordinary zeolite unit effluent to carbonic acid (H_2 CO_3), from which air blowing in degassification chambers removes the (CO_2) to leave sodium free water with only traces of carbon dioxide. In addition, these interesting zeolites may be regenerated with brine where the residue of sodium salts is not objectionable or the two types of units may be operated in parallel, whereupon the mixed effluents neutralize each other to produce carbon-dioxide and a finished water with one-half the cation content (calcium, sodium, etc.) of the original water. In high pressure boiler operations freedom of silica from the finished water had proved an outstanding attribute of the hydrogen zeolite method of producing make up water. Mr. Applebaum cited cases where lime-soda softened waters, coagulated with iron salts as the superior coagulant for silica removal, and finished through hydrogen zeolite had served successfully as 100% make-up water in boiler operations.

In the typical case records and water analyses presented one power plant, operating on 1250 lb. boiler pressures and employing raw water of essentially calcium and magnesium salts, by mixing and degassifying effluents from sodium and hydrogen units produced a make-up water of 4 p.p.m. total alkalinity, zero to 3 p.p.m. hardness, and only 36 p.p.m. total solids. In another case deep well water containing better than 630 p.p.m. alkalinity had been successfully treated through hydrogen zeolite (alone) to produce an aerated product satisfactory for ice production, and replacing costly distillation. No replacement of zeolite had been required during three years of operation and there had been no accident in the acid handling.

Several other case records for boiler water production were cited to indicate the variety of waters successfully processed and the flexibility of hydrogen zeolite in combination with precipitation methods and/or sodium zeolite. A particularly interesting case was that of a mid-western city supply of filtered water varying markedly in total hardness. From this water a combination of sodium and hydrogen zeolite units automatically produced a uniform make-up water of zero to 2 p.p.m. hardness, alkalinity of 15 and total solids reduction of 180 p.p.m. The hydrogen zeolite effluent, before mixing with sodium zeolite effluent of 194 p.p.m. alkalinity, contained 222 p.p.m. free mineral acid plus 170 free carbon dioxide. The scheme was chosen on the basis of overall costs in comparing all proven methods of production of satisfactory boiler water from available sources of supply.

In concluding, Mr. Applebaum stressed the part taken by hydrogen zeolites in rendering higher pressure boiler operations and raw water ice production practicable of attainment, likewise the enhanced practicability of utilizing municipal supplies which notably vary in composition with changing stream conditions.

HOW "GOD'S GIFT TO MAN" COMES TO HIM WHOLESOME AND PALATABLE*

Or, Telling the Water Purification Story to a Non-Technical Audience

By MARTIN E. FLENTJE, Chemist
[Illustrated by H. W. Montague]
American Water Works and Electric Co.
NEW YORK, NEW YORK

AN OPPORTUNITY to talk about water to any group or club should be readily embraced by any water-works man who is given such an invitation. Water is essential to life, and its delivery under pressure with unfailing continuity of service in an attractive, palatable and pure state is a job any of us can be proud to be connected with, and one which should properly interest your fellow townsmen. Such an invitation to talk will present an opportunity to boast a little about your industry, about which, incidentally, very little is known by the general public.

The 12,000 organizations in the water supply field provide a wholesome and essential product to 80,000,000 people in the United States, making it an industry of great significance. Its estimated annual income of $450,000,000 is somewhat below the $800,000,000 cigarette industry, but puts it into a class with such important and sizable products as "Butter", "Boots and Shoes", "Canned Foods". And, it is pleasing to note that it is well above the industry listed as "Caskets and Coffins" (income $94,738,000) and almost ten fold that of the "Chewing Gum" industry. Our industry's 60,000 to 75,000 employees place it in the "Men, Youths' and Boys' Clothing", "Glass", and "Confectionery" classes. These figures indicate that water supply is not only a large and important business, but also that it is an integral part of our economic life.

Accomplished Speaking Not Necessary

The writer is qualified to tell the story of but a small portion of the water supply business. However, probably because of its association with the now popularized sciences of chemistry and bacteriology, this phase of the production and distribution of water does appear to interest people greatly, and is easily presented. Experience has shown that it is not at all necessary to be an orator, or even an accomplished speaker, to make this branch of the business interesting enough for the speaker to be showered with questions after his talk on the subject. The following material, then, is primarily concerned with telling of the story of water supply from the treatment and purification side.

The Author

Some brief "don'ts" should, I believe, be emphasized, and the writer apologizes for being presumptuous enough to outline them. If your audience happens to be a luncheon or dinner club, and your meal with them doesn't taste very well and you find yourself nervous, don't worry, for this is a natural reaction even for speakers with wide experience. It will correct itself when you once get up on your feet to talk, because you will know what you are talking about. Don't make your talk too long!! A talk before a service club five minutes shorter than the allotted time will be much more favorably received than one lasting five minutes overtime. Don't feel that it is necessary to tell a funny story. Unless you are a better teller of such stories than is the average person your story will have been heard by many, and it may not appear very funny to the rest of your audience. Moreover, water purification is too interesting and important a subject to justify any wasting of time on the two not-so-funny Irishmen. Don't try to orate, and don't worry a great deal about your delivery. Be yourself, and at ease. Then just speak naturally in a conversational tone of voice, but try to make certain that it is loud enough for all to hear. Talk to the man in the rear of the room. Then proceed just as though you were conversing with your neighbor, telling him about your job and work in which he has shown an interest. Above all, *don't read* your "speech".

Don't Worry! You'll Feel O. K. When on Your Feet

Now—On Your Feet

Now you have been introduced and are on your feet—on your own, as it were. The Chairman's introduction has quieted the room and secured some attention for you. It is necessary that this first interest in you as the speaker be continued and converted and intensified to include the subject of your talk. Some speakers use the funny-story-beginning to gain further attention, with the often disappointing results hinted at in the previous paragraph; others

*A paper presented before the New Jersey Section of A.W.W.A. and printed by permission of the Association.

Better than a Not-too-Funny Story is a Little Water Magic

use some more definite attention-pulling scheme. For our particular purpose, the magic generally associated with the science of chemistry may serve the desired purpose. Changing "water to wine" is no trick at all with a goodly dose of phenolphthalein indicator in the magic pitcher or tumbler into which you pour "plain water", treated beforehand to contain carbonates or hydroxides. Yet such a stunt is certain to introduce the subject in a spectacular manner. The stunt can be continued by making the Chairman your accomplice. Ask him to blow through a glass tube into the water and cause the "wine" to become water again. This is a case of recarbonation and it works quicker if sodium carbonate (and not too much) is used. By all means, practice your stunts to perfection beforehand.

In this manner a magician might "introduce" water, and indeed it would be appropriate for a magician to make a talk on water—not only would it require magical powers to tell all about water in the short period usually allotted to a speaker, but only a magician could do justice to this remarkable compound.

Water in General

Indispensable to life, water is generally (and too casually) accepted as "God's gift to man"; and, the need for improving the "gift" is only really appreciated when it becomes impaired in quality or quantity. It makes up a large part of our person (75%), and is a constituent of all food. In spite of periods when we are aware of its near absence in droughts and dry spells, it is surprisingly abundant—so much so that if all of the earth's mountains and ocean depths were levelled off, the entire world's surface would be covered with water to a depth of approximately two miles. It possesses properties that emphasize its magical character; its familiar formula (H_2O) is now known to represent but one of its many forms. It will surprise your listeners to hear that, in all, 33 formulæ are required to cover its various forms, all of which, however, are combinations of the basic elements Hydrogen (H) and Oxygen (O).

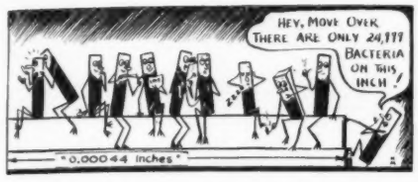
Water is the most common and probably most efficient of fire-fighting substances, yet this would hardly be surmised from an examination of its components. Hydrogen, as brought to public attention by the Hindenburg disaster over New Jersey, is a highly inflammable and explosive gas. Without oxygen, however, no combustion or explosion can take place. Water, the least costly and least publicized of any of the commodities of the utility services, became suddenly famous several years ago when the scientific curiosity — "Heavy Water" — was first discovered. This new compound, first so expensive to produce that thousands of dollars were paid to obtain only a few ounces of it, has since become relatively cheap at $25,000 a quart! Its properties affect our climate as our New Jersey shore communities well know. Not so well known is the fact that its character in zones of freezing weather has made it possible for us to survive and live in the colder climates. With declining temperature water becomes heavier, this continuing until 4°C. (39.3°F.) is reached. Then the great phenomena! Suddenly, further cooling results in its becoming lighter. This is the reason why our rivers and lakes freeze from the top down, rather than from the bottom up. Freezing from the bottom up would result in conditions horrible to contemplate. The cover ice serves as the insulating blanket to preserve marine life beneath.

This, then, is water—an oddity intensely interesting, but actually not the product we sell and serve. The water coming from your household faucet is still "God's gift to Man" with all its natural characteristics preserved, but processed and improved to meet the requirements and conditions of modern living. It is in reality a manufactured (processed) product, produced in such quantities that your pumping station and purification plant is probably the biggest "bulk" production plant in town. It is also peculiarly a product of the community; it has probably never occurred to your listeners that they, without thinking, use the terms "Chicago Water", "Atlantic City Water", etc., thereby unknowingly recognizing and acknowledging the difference in these supplies. Such differences are caused by the presence of minute concentrations of dissolved mineral matter. A change from a water having the composition 99.998% H_2O and 0.002% dissolved matter to one with 99.800% H_2O and 0.200% dissolved material, approximately represents the difference between America's softest and hardest municipal supplies. The layman will need a microscope to perceive that the small figures represent a hundred fold difference in solids in the two waters.

Your "Bacteria Club" Suffers a Severe Loss of Members in the Reservoir

Getting to the Home-Town Water

Your hearers are perhaps anxious by this time to have you start getting down to cases and telling them about what is done to the water delivered to them. The extent to which this is gone into will naturally depend on the type and degree of treatment given the local water. If storage, sedimentation and filtration are used, your capacity as a magician may again be called upon, this time to produce a magic carpet to transport the group to a sunny hillside spot for a picnic dinner, transforming your followers into lowly bacteria while en route. As such, things will



25,000 of Your Guests Can Now Sit on One Straw an Inch Long

seem strange and unusual. For example, 25,000 of those coming along with you will be able to sit on a straw or a pine needle one-inch in length, without crowding either. Then, their growing up will be rapid, for maturity will be reached within 20 minutes after you have transformed them into "bacterial babies". But, unsightly middle-age bulges will be conspicuously absent—for indeed so thin will your guests become on growing up that they will actually "break" in two, for bacteria are "fissure" organisms and multiply by division. If we now imagine a heavy rainstorm catching them unawares, we can start their inspection trip under conditions that are actually found in nature. Your members of the "Bacteria Club" will be splashed and tumbled about and washed along, first into brooks, and finally into sizable streams and rivers. Along the way their number will be greatly increased, and many folks, lower in the social scale, will be encountered, even to many from "across the railroad tracks", including such gangsters as the pathogens which cause dysentery and typhoid fever. Your guests will learn from their "experiences" that rapidly running water does not necessarily purify itself, for with every increase in volume of water and velocity, more and more pollution will be added to the stream as it travels. Suddenly the rapid bouncing journey will end in the quiet waters of the reservoir, to be the home of your "Club Members" for a year (or whatever the storage period may be). All, however, will not be peaceful. Distressing will be the high mortality rate of both the good and harmful organisms in your troupe. The natural settling out of suspended matter carried by the streams will carry many of your "Bacteria Club" members and hangers-on to their graves on the reservoir's bottom. Sunlight will aid in the destruction of the gangster pathogens, noticably the typhoid "gang," which are obviously out of their natural habitat. After seven days few of this unholy fraternity will survive and practically none after fourteen days. That the length of storage (age) of water bears no relation to "stagnant water" will also be observed, for stagnation is the result of absence of air. This was possibly demonstrated by an exciting adventure when a strong convection current carried them far below the surface, among strange creatures living without air (therefore called anaerobes) whose manner of living resulted in a strong odor of "rotten eggs" (hydrogen sulfide), colored water, and the presence of objectionable manganese and iron that stain enamel fixtures and clothing.

What Happens to Your Survivors

Finally, only 20 or 30 of each 100 of the original group entering the reservoir leave it through a dark tunnel, and on to new dangers more rapidly happening than the former. Here in the mixing basin of the filtration plant, every trick at their command is required to escape the clutches of the gelatinous masses (net-work) of aluminum hydroxide floc, produced when the coagulating alum is diffused through the water. So successful is this entanglement that in the subsequent slow trip through the plant's settling basins tons of sediment and thousands of bacteria are removed. The original hundred now numbers but 5 to 10 or even less, and these find the graded sand filters—next in the purification process—an almost impassable barrier. If by hook or crook this barrier is pierced, such an organism is certain to meet instant death at the hands of the highest of the arch-enemies of bacteria—Chlorine, murderous in even the minute dosages used. Your guests are now all put out of existence—like it or not.

How the Chemist Knows His Job Is Done

This ends the magic journey; coming "back to life," your hearers may be interested in seeing how bacteria look growing on an agar or E.M.B. plate and how the chlorine application is actually controlled. The residual chlorine test is one quickly performed and is a good visual example of the control of purification processes. Because chlorine is so well known, and blamed for so many ills, it may be well to point out that it is continuously applied through sensitive and expensive machines and in quantities so small that all the water used by a family of four in an entire year would have had added to it considerably less chlorine than it consumes in the form of table salt. Actually the chlorine dosage is less than an ounce per consumer per year.

In some such way your hearers may be conducted on a tour of your plant—this particular tour has purposely been made as non-technical as possible. Taken in whole, it is probably too lengthy for the average talk, for time should be left for questions which will be sure to come if your job has been at all well done.

And, the Toughest of the Lot Become Just So Much "Cannon Fodder" When They Come in Range of the Sentry of the "Green Goddess" Standing at the Sally-Port

PENNA. WATER OPERATORS ASSOCIATION CONTINUES TO FLOURISH

Inventor of Erie Filter Bed Agitator Awarded President's Cup; Past-Presidents and Secretary Presented With Emblems

An Editor's Lament!

This report will look no less strange to our readers than to ourselves. This time the old adage that *"One picture is worth* 10,000 *words"* doesn't go—because there are no pictures. It is our first experience of a 100% failure to get pictures for illuminating and enlivening reports of meetings.

The sad truth is that our usually excellent photo-finishers slipped a cog somewhere and our films of 72 exposures came out of their developing bath about as transparent as is the material of which they are made. And—there was nothing that could be done about it.

So, with apologies to the Pennsylvanians, we regret the necessity of running these "words without music."—ED.

THE Pennsylvania Water Works Operators Association held its 12th Annual Conference at State College, Pa., June 28, 29th and 30th, contiguously, and in some aspects jointly with the 13th Annual Conference of the Penna. Sewage Works Association. Each year the attendance at the meetings of these two associations has been increasing. This year the official registration for the Water Operators Association reached an all time high of 266, to which several late comers who failed to register might be added.

Growth and Prosperity of Ass'n Revealed

Starting with a mere handful of members some 12 years ago, the Pennsylvania Operators Association, which holds its annual meetings on the tranquil centrally located campus of State College, where members and guests are economically quartered in the college dormatories, has grown to become one of the most important of the state associations and attracts many from other parts of the country. In addition to its annual three day meeting, the association has an Eastern and a Western Division which holds one day interim meetings during the year.

I. M. Glace, for the past several years the association's energizing Secretary-Treasurer, revealed in his annual report a growth in membership which now stands at 434. Total receipts for the year closing ran to $2,214.62 and disbursements to $1,-930.38. Of the latter, $1,014.93 represented the cost of producing the association Journal, supported by an advertising income of $1,009.50. That the business affairs of the association have been well managed is indicated by the $768.58 reported as "balance on hand" at the year end.

Vote on Licensing Deferred

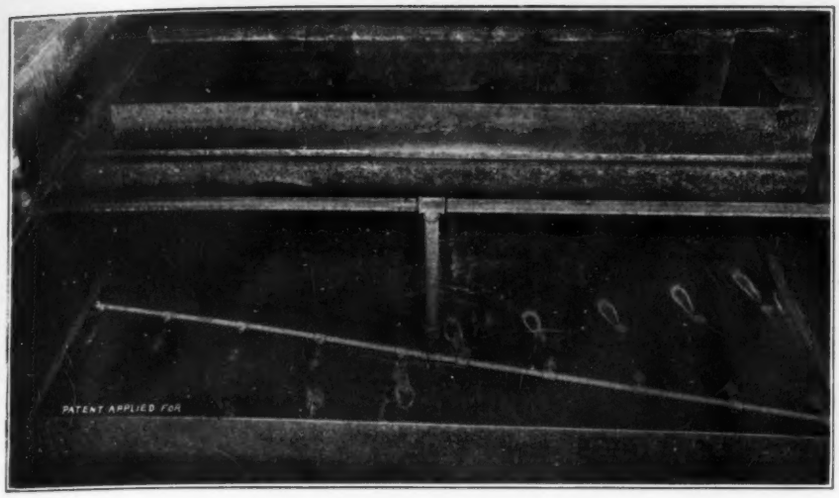
The proposed licensing act, drawn by the Committee on Operator Licensing after several years of study, was briefly presented by Chairman E. D. Walker. The understanding is that copies are to be mailed to members for the purpose of hearing objections and receiving suggested improvements which might be incorporated before voting on the question of its presentation in the next session of the State Legislature. The proposed act calls for automatic licensing of all superintendents and operators holding positions for a year or more before the act becomes effective. It, however, gives the Secretary of Health power to revoke licenses whenever incompetence or neglect of duty can be shown. Likewise, qualifications of applicants are to be determined by examinations under direction of the Secretary of Health.

President's Cup to Palmer

To that member presenting the most valuable paper before the association during the year the President's Cup* was voted to C. E. Palmer, Filter Operator, Water Department of Erie, Pa., for his noteworthy contributions in perfecting filter washing by means of bed agitation and the hydraulically driven mechanism, invented and perfected by Mr. Palmer at the Erie Filter Plant. Mr. Palmer's prize winning paper, which describes the filter bed agitator and its functions, and presents results attained in its use at Erie and elsewhere is given deserved space further on in this report.

In accepting the cup, Mr. Palmer, flushed, and hard put for words to adequately express his surprise and appreciation, said that he first owed a debt of gratitude to his superiors, Jas. S. Dunwoody, Gen'l Sup't, and Geo. W. Papesch, Plant Sup't at Erie, for making the development of

* Award of The President's Cup was conceived and the cup was donated by H. M. Freeburn, when president in 1934-1935.—Ed.



The Palmer "Filter-Sweep"
To the inventor of Erie's revolving-jet filter-bed agitator went the President's Cup

the Erie agitator possible, and for their valued assistance.

Emblems to Past-Presidents

The association presented to its 11 past-presidents and its first secretary and present secretary-treasurer, neat gold watch-chain emblems of keystone shape with red enamel face and engraved with name and years of service on the rear.

On hand were 8 of the following 11 past-presidents to personally receive recognition and the attractive service emblems:

L. D. Walker.....(1928-'29)
C. F. Drake.....(1929-'30)
J. F. Dunwoody.....(1930-'31)
G. R. Taylor.....(1931-'32)
E. C. Trax.....(1932-'33)
M. E. Flentje*.....(1933-'34)
H. M. Freeburn*.....(1934-'35)
C. L. Fox.....(1935-'36)
W. C. Emigh*.....(1936-'37)
G. W. Knight.....(1937-'38)
J. C. DeGroot.....(1938-39)

* Absentees; Mr. Freeburn had been present, however, until unexpectedly called away.

Professor Walker Honored

By both the Water and Sewage Works Associations were the services of Professor L. D. Walker recognized as the first president of each. The occasion was also the eve of his retirement from active work as faculty member of State College and teacher of many members of the two associations.

In the closing exercises, as a token of esteem, a handsome watch was presented to Professor Walker by Arthur P. Miller (U. S. Public Health Service) who made the presentation on behalf of those sanitary engineers who had been privileged to take courses under Dr. Walker at State College.

Officers 1939-1940:

The following officers were chosen for the ensuing year:

President—C. J. Bruce, Sup't, Evitts' Creek Water Co., Evitts' Creek, Pa., and Cumberland, Md.

1st Vice-Pres.—L. D. Morgan, Distr. Engr., State Dept. Health, Greensburg, Pa.

2nd Vice-Pres.—H. J. Krum, Sup't Filtration and Sewage Treatment, Allentown, Pa.

Sec'y-Treas.—I. M. Glace, Cons. Engr., Harrisburg, Pa.

Joint Golf Tournament

According to custom, the two associations held a joint Golf Tournament, the low gross score being turned in by P. M. Hess of Safe Harbor, Pa., and the second low being the score of George Williams of Honesdale, Pa. Other prize winners were R. H. Snyder, Ralph Tyler, R. I. Dodd, G. I. Saylor, George Boone, Ed C. Trax and I. M. Glace.

1939-'40 Meetings Scheduled

It was announced that the dates for the 1940 meeting at State College have been set as June 24th-28th, with the Sewage Works Association meeting on the 28th-30th. As usual the dormatories will be available.

The Eastern Division of the Water Operators Association will meet jointly with the Four States Section of A.W.W.A. in Reading, Pa.; the Western Division jointly with the Western Pa. Section of A.W.W.A. in Johnstown, Pa., September 18th-20th.

The "Microvivarium" Comes to State College

The novel **"Microvivarium,"** which has created so much interest in the exhibit of Westinghouse at the New York World's Fair, was reproduced at State College, Pa., by its creator and director, Dr. George Roemmert, who made a flying trip, with a collection of organisms, for the purpose. The interesting method of showing many forms of living organisms greatly enlarged on the screen, and in actual action, allowed Dr. Roemmert to demonstrate methods of reproduction and other life habits, the preying of one form on another, the effect of chemicals, etc. This demonstration—one of the most unusual and lucid ever witnessed—was arranged as a joint "bill" by the Water Operators' and the Sewage Works Associations.

Technical Sessions

The Technical Sessions were opened with a lecture on **"Some Fundamentals of the Chemistry of Water"** by JOHN J. SHANK, Director, Wayne Laboratories of Waynesboro, Pa.

This lecture and demonstration, a continuation of earlier lectures by Mr. Shank, dealt with hardness and alkalinity of waters, methods of titration and evaluation, pH determination, and the use of various laboratory equipment and indicators in hardness and alkalinity determinations.

"A Simple Method of Testing Centrifugal Pumps" by HOMER E. BECKWITH, District Engineer, The Pitometer Co., Harrisburg, Pa.

In Mr. Beckwith's very effective presentation, he went into the basic principles of the centrifugal pump and the relationship of speed of propeller at its periphery and pressure head produced in the casing. Then he presented typical efficiency curves for centrifugal pumps and gave an analytical interpretation of their component parts and the meaning of such terms as "specific speed," "critical efficiency," "plateau of efficiency," etc. He then laid stress on selection of centrifugal pumps on the basis of fairly exact local requirements, which some one of the manufacturers might best meet with the designs offered. As a rule he advocated limiting suction head to 15 ft. maximum and picking pumps with relatively steep head-capacity curves to the right of the point of critical efficiency. Thereby the potential efficiency drop with increasing

pressures, created by higher demands or future friction build up through the mains, would be of less magnitude. He went on then to show that salvage of old pumps might be rather costly unless before placing such in new duty service the impeller design, speed, or both, be altered by the manufacturer to meet the new requirements.

In continuing old pumps too long in service, when considering efficiencies of modern design vs. old, the high cost of obsolescence was illustrated by case histories showing that the cost of new motor-pump units had frequently been paid for in power saved during the first year of operation. Outstanding was the case of Charlotte, N. C., as recounted in WATER WORKS & SEWERAGE for March, 1939, wherein even at the very moderate power rates new units had been responsible for reducing pumping costs of $16.00 per million to $7.50, netting an $18,000 annual saving in power bills at Charlotte.

Mr. Beckwith then explained the simplified method and procedure followed in making tests for wire to water efficiencies of pumping units, as frequently as desired and with little effort. (Such is given in his paper clearly and concisely, with actual examples. Since this very useful paper is to be printed in full in our next issue, an attempt to cover it in digest fashion here would seem to be unnecessary.—Ed.)

F. S. FRANKLAND, Engineer, Worthington Pump and Machinery Corp., Pittsburgh, Pa., in discussion, pointed out that Mr. Beckwith's ideals could not always be met. For instance, when pumping at various rates against fairly constant head, such as is true when pumping directly into mains, pumps with flat head-capacity curves are necessary. (Another excellent argument for floating storage on the system. With this, Mr. Frankland later in his evaluations appears to be in agreement. —Ed.) He pointed out that overall efficiency for average operating heads meant that pumps of lower design efficiencies than some others might be the more economical unit in the end.

Mr. Frankland explained the marked desirability of limiting suction lift to the absolute practicable limit, and stated that where suction lift is high it is impossible to pick a pump to meet the desirable points as to steepness of head-capacity curve, therefore, larger more costly and less efficient units must be chosen.

Mr. Frankland then cited the seeming loss of appreciation of the value of reciprocating pumps which continue to have a place in water works operating economy and at times should be substituted for centrifugal units, especially for low capacity and high heads. An example cited happened to be that of a nearby city, wherein pumping at rates of 200 g.p.m. against 300 lbs. pressure was accomplished with a 50 H.P. motor driven reciprocating pump at 82% overall efficiency. The nearest available centrifugal unit for the purpose, yielding a possible overall efficiency of 72%, would have necessitated 125 H.P. motors with its higher demand charge and 10 points lower efficiency. The moral is, said Mr. Frankland, "do not overlook the motor driven reciprocating pump" even though it may cost a bit more for the installation.

In reply to the question of what improvements had been responsible for the increased efficiency of centrifugal pumps, Mr. Frankland stated that more efficient blade angle and design and materials employed to reduce leakage by the wearing rings constituted the principle improvements. He warned, however, that many times the initial efficiency, obtained by reduced clearances, might prove more costly in the end than if installing a lower clearance unit less subject to declining efficiencies, resulting in a net gain after a few years of service.

"Automatic Regulating Valves—Their Functions, Use and Operation" by WM. F. END, Chief Engineer, Ross Valve Mfg. Co., Troy, N. Y.

Mr. End presented a brief description and the workings of various types of automatic regulating valves most effectively employed in controlling reservoir elevations and pressures on distribution systems. Also, the control of directional flow through systems served by reservoirs having various elevations and the automatic cutting in of fire reserve supplies. Other valves included air-bleeding and air inlet; emergency shut off valves for reducing water hammer or preventing vacuum on mains due to failure; pressure relief or snifter valves for surge relief at pumping stations. Employing lantern slides depicting typical installations of such valves, singly or in combination, one case was that of time clock controlled pressure reducing units installed to reduce pressures at night and thereby limit waste through unmetered services and loss through leaks. Another valve automatically reduced deep well pump discharge rate to preclude excessive draw down, excessive pumping costs, or well damage. Another combination of valves, being now more widely employed, is that which allows a floating tank to fill during hours of off peak usage, thereafter remaining full until pressure drop on the system created by usage peaks automatically throws the full tank on the line until pressure recovery places it in a filling status again. At least the foregoing constitutes samples from the "bag of tricks" which Mr. End's valves can perform for improved service, safety and operating economies.

CHAS. L. FOX, Chief Engr., Penna. Water Service Co., Wilkinsburg, Pa., in his discussion from the viewpoint of the operator, stressed the value of effective placement of air release valves on force mains or supply mains, and the desirability for effectively maintaining such valves to preclude loss of main capacity and pumping efficiencies due to air collecting at high points. The value of pressure control valves was also stressed as the means of reducing waste and unaccounted for water; also making permissible the use of thinner wall pipes in mountainous locations. In their adaptation as automatic check valves, the cone type valve, with regulatable rates of closure, had become so well recognized that little comment seemed necessary. In matters of automatic valve selection and location, he advised consultation with the manufacturer's experienced engineers, after giving as complete specifications as possible concerning the duty expected of such valves.

Filter Bottoms. Types, Functions, Performance

To open the discussion of **"Filter Bottoms, Types, Functions and Performances"** CHAS. F. THOMAS, Vice-President, Roberts Filter Mfg. Co., was scheduled on the program. In his absence Prof. Louis V. Carpenter, by way of pinch-hitting, "held class" on this topic. He reviewed the basic requirements of a filter bottom for effective distribution of wash water. By the "Question and Answer" method, Prof. Carpenter started with the manifold, lateral and strainer type of high pressure wash, proceeded through the development of the low pressure false-bottom which had its serious deficiencies of uniform wash water distribution; then the medium pressure Wheeler (pyramid and ball type) bottom, now being consider-

ably employed. The grating type false bottom of the Morse Type Filter was described as an open low pressure type which had seemingly performed well in the early installations, in spite of arguments against such a high ratio of area of openings to area of sand surface.

The new type porous-plate filter bottom Professor Carpenter left to be discussed by Mr. Roe who was to follow him.

E. C. TRAX, informed Professor Carpenter that in recent designs of the all-steel Morse units the false bottom consisted of a gravel supporting plate of solid metal, with strainers rather than the open grating first employed.

"Porous Plate Bottoms" by FRANK L. ROE, Engineer, The Carborundum Co., Niagara Falls, N. Y.

Mr. Roe described tht two types of filter bottoms involving the use of porous plates of fused coarse material, such as represented by plates of **"Aloxite."** In one design the plates form their own lateral channels when cemented to a solid floor; in the other the plates are bolted in position to form a false bottom unit. Such plates now in use for 4 years in 30 installations require no gravel layers to support the sand bed which rests squarely on the porous plate bottom, the bottom sand being of grain size larger than the voids in the fused plate.

Mr. Roe, in enumerating the proven advantages of the porous plate bottom, cited the fact that in the absence of gravel bed inversion was an impossibility; air and water wash could be used separately or combined at will; filters could be built with less depth of box, and with less head required through the plant as the result. Amongst installations were some in lime softening plants, others in zeolite units. In one instance rehabilitated filters were now washed with freedom from mud-ball troubles for the first time.

Answering the chief question—"Will there not be clogging of such plates in time?"—Mr. Roe said that, based on four years experience, the answer was "No." Where initial head loss after washing had gradually crept up caustic soda had been applied to the plates (without removing the sand) to dissolve the alumina in the voids. Now a yearly treatment, the initial loss curve had become flat and each yearly caustic treatment reduced the figure to that following the previous cleansing. For removing carbonate encrustation in the softening plant at Grand Rapids, Mich., inhibited acid had been used, without effect on the acid resistant plates.

[There seemed to be considerable interest in filter bottoms but unfortunately discussion was curtailed due to lateness of the hour.—Ed.]

Improved Filter Wash With Revolving Agitator.

"Use of Modern Agitation in Filter Washing" by C. E. PALMER, Water Department, Erie, Pa.

Presenting what later proved to be the paper which won for its author The President's Cup Mr. Palmer, who invented the Palmer Filter Bed Agitators at the Erie Filter Plant, described his novel multiple water-jet driven revolving agitator which has already been described by its inventor in detail in the Oct. 1938 issue of this magazine.

Mr. Palmer, a practical operator who saw the distinctive advantages of the filter bed surface-wash system developed by John R. Baylis and since installed in a number of plants, conceived and developed the two arm revolving agitator which is an exceedingly simple device to install and interestingly maintains the corners of rectangular units in as good condition as the circular area swept by the revolving jetting arms. Mr. Palmer has since arranged for production and marketing of the Palmer "Filter-Sweep," which has already gone into several plants with results recorded in his paper and substantiated by users. (The term "Filter-Sweep" was of our own coinage in captioning pictures of the agitator which appeared with the first published article. It is only fair to say that the inventor felt that it was not sufficiently descriptive on the score that mere sweeping usually involves the clearing away of surface deposits alone, whereas the revolving agitator jets actually dig down to cleanse the sub-surface sand as well as the surface.—Ed.)

Mr. Palmer's paper reviewed the history of the agitators in the Erie plant, and their gradually improved design since 1937 which has resulted in complete equippage of the Erie plant with these effective wash-water saving bed cleansers. Amongst early demonstrations of effectiveness the most spectacular came with the substitution of **"Antharfilt"** for upper sand layers. While the **"Anthrafilt"** washed free of mud more satisfactorily than the sand it was found that a mud blanket had built up in the partition zone between the sand and the **"Anthrafilt."** Application of the jet agitator brought this mud to the surface and quickly solved the problem, making feasible the desirable **"Anthrafilt"** and sand combination without excess bed expansion and consequential loss of the lighter gravity filter media. Then it was shown that the jetting wash followed by low velocity water wash made an all **"Anthrafilt"** bed permissive with low free-board. Long period plant scale comparative tests indicated that the combination of jetting and slow up-flow wash reduced wash water from 3.5% for the all sand units to 1.7% for the combination sand-Anthrafilt units (1.24% for the all **Anthrafilt** units) with lengths of filter runs 24 hrs., 75 hrs. and 120 hrs., respectively, during periods of a heavy algae load when ordinarily the sand filters required frequent "bumping" by cracking the wash valve at intervals to loosen up the beds. In the wash procedure with the revolving agitator, just sufficient up-flow water is admitted through the regular underdrain system to render the bed fluid enough to permit the agitator arm to revolve under force of the jetting pressure of 50 pounds, the balance of the water being supplied through the agitator for maximum bed penetration and scouring action. In reply to questions, Mr. Palmer stated that a 15 inch per minute up-flow was ample to make a sand bed sufficiently fluid and a considerable lesser rate was sufficient for **Anthrafilt.** About 276 g.p.m. was used at Erie through the agitators operating at roughly 9 revolutions per minute through the liquefied beds.

Mr. Palmer revealed that a large mid-western paper mill had installed "Anthrafilt" and "Filter Sweeps" and according to reports sufficient alum and wash water had been saved during the first 5 months to pay all installation costs. At the same time satisfactory water had been produced at filter rates of better than 4 g.p.m./sq. ft.—almost double the design rate.

RENNIE I. DODD, Supt. of Filtration, Chester Water Service Co., Chester, Pa., complimented Mr. Palmer on his contribution and said that his experience with sand-anthrafilt beds paralleled that of Erie, proving the value and effectiveness of the surface wash for maintaining clean beds. He had found all operators employing the Palmer scheme enthusiastic over the results attained.

In replying to a question put by Mr. Dodd as to how deep the jets from the slanting 3/16 inch nozzles penetrated the sand bed at 50 lbs. pressure, Mr. Palmer replied that the liquidity of the bed governed the

depth of penetration. However, it was not necessary to secure complete penetration of the bed because the jetting effect seemed to cause the sand bed to move down at the sides and corners and upwards toward the center. Thus all sand sooner or later came into range of the power jets due to this turnover of media. (This explained why the corners and edges became effectively cleansed. Although the jets never reach the corner areas, into these the scoured top sand is constantly thrown and sinks because of bed fluidity.—Ed.)

E. C. GOEHRING, Supt. of Filtration, Beaver Valley Water Co., made brief comments on results of a 6 unit installation of "Filter Sweeps" in service for 4 months. The work done had been all, and even more than, that which Mr. Palmer claimed for the Erie units. High rate washing had proved a failure because of the gummy nature of the sand coatings — especially where lime and carbon had been employed ahead of the filters. One of the most impressive demonstrations resulted when an apparently cleaned bed, by ordinary wash, was then further washed with the agitator. In short, the wash job had to be done all over again. Like Erie, a wash water reduction had been noted, but the chief value was an effectively cleaned bed.

W. R. WHITLEY, Hammermill Paper Co., Erie, Pa., reported on results with a trial installation of anthrafilt and agitators in his company's 35 m.g.d. plant. Actually the filter rate of the 2 m.g.d. units had been boosted to 4 m.g.d., the quality of effluent being equal or superior to the unequipped sand units operating at customary 2 m.g.d. rates. Filter runs had been lengthened by 50%, even when washing at 6 ft. head loss to prevent possible leakage of turbidity through the coarser beds of anthrafilt.

L. H. ENSLOW, Editor, WATER WORKS & SEWERAGE, said that he thought that Mr. Palmer might well add another axiomatic point in favor of effectively cleansed beds—namely, the fact that a "clean tooth doesn't decay." It is probably not thoroughly appreciated that in hot weather the products of decomposition in dirty filters add something of a taste and odor hazard. It is only necessary to compare chlorinated effluents from clean and dirty units in warm weather to demonstrate this point—or, just try application of ammonia and chlorine ahead of a dirty bed in hot weather and note what comes through.

Arithmetic of The Filter Plant

"Arithmetic of The Filter Plant" constituted the topic of the second evening session.

The discussion of some fundamental considerations in filter plant design and operation, as presented by PROF. H. E. TURNER of State College, who is Research Engr. for The Anthracite Equipment Corp., proved interesting and thought-provoking. His remarks were very much to the point in the direction of a diagnosis of what ails many filter plants, by one who neither designs or nor operates such plants but has applied analytical thought to operating troubles and possible design betterments. The Professor, in a position to speak his mind fully, does a good job of it in questioning the reasons for adhering to outmoded standards in filtration practices and, more particularly, in plant design.

In general, Prof. Turner's analyses and questions raised were very much along the lines covered in his paper which appeared in the Oct. 1938 issue of this magazine. He started with the laboratory floc control tests, so necessary for economy and, as he put it, "for building a floc to suit the plant, since the plant cannot be built to suit the floc." From there he went into mixing chamber fundamentals and then to clarification basins, which for the most part can generally be made more efficient by design improvements and effective placement of baffles. In analyzing filter troubles he divided the unit into "bottom" (underdrainage and wash distribution), "middle" (the filter bed proper) and "top" (the wash troughs). He emphasized the fact that with departure from agitation of filter beds with air or by mechanical means, and the swing to the low pressure high velocity wash, filter bed troubles began to multiply. He advocated scrubbing wash at low velocities of wash rise, 30 in. deep beds of coarse sand or other media, increased rates of filtration up to 4 g.p.m./sq. ft., reduced gravel bed depth and improved wash trough design by providing more and narrower V-shaped troughs to hold down sudden wash rise velocities between the troughs. With proper scrubbing agitation of the bed Prof. Turner feels that cross wash troughs may be reduced to a minimum, if not completely eliminated, since the finely divided dirt (scour) can travel far without settling back to the bed.

Interesting were his comments on the decades of changing styles in filter design. Not long since, the fashion swung to high velocity wash and employing bed agitation of any nature and low free-board was considered "old fashioned." With present trends it seemed certain that the reverse will soon be true. It will be considered "old fashioned" *not* to provide filter bed agitation by water jetting, by air, or other means. The mudball-making high free-board, large obstructing wash troughs, and other costly features of high velocity wash design will disappear.

In essence Prof. Turner stated he was convinced that higher filtering rates have come to stay, because cleaner beds will become the order of the day and 33% or better of loafing beds will not longer be mudball and hard-spot bound, while the clear sections do all the work. Minimum permissible free board was the common sense "2+2 arithmetic" of filter design and maintenance, with minimum washing troubles and lowest costs. Lower free-board necessitates coarser filter bed grains and these in turn necessitate deeper beds performing a duty from top to gravel while the "smutchdecke" remains on the scrap pile. In turn, supporting gravel beds can be thinner and of smaller gravel when this era of hydraulic four-wheel brakes overtakes the filter and a penetrating and scrubbing top wash is given its due place in the march of filtration progress. In opposition to the proponents of high velocity wash Mr. Turner argues that the hydraulic sand blast treatment in bed agitation schemes is definitely another bit of "2+2 arithmetic," when making comparison with buoyant water cushioned coated sand grains floating apart in a stream of high velocity up flow wash to preserve their "skins."

Water-Borne Epidemic Round Table

The closing half day session was devoted to a "Round-Table on Water-Borne Epidemics" conducted by A. E. GRIFFIN of Wallace & Tiernan Co., as leader.

Mr. Griffin opened the discussion with a review of the synposium held on the same topic during the recent convention of A.W.W.A. in Atlantic City, and covered in another report appearing in this issue. While some were inclined to question the dependability of existing methods of treatment and bacterial index of quality the concensus of opinion, said Mr. Griffin, pointed to failures in applica-

tion of existing processes or equipment, rather than inability of such processes (when adequately applied) to cope with outbreaks of gastro intestinal disorders attributed to water quality. Little evidence has been forthcoming to indicate that such intestinal disturbances have been caused by toxins or products of organic decomposition. Mr. Griffin sounded a warning note on the orthotolidin test which could be misleading in the presence of manganic compounds and other oxidizing agents, which produce a false residual color. Later in the session I. M. GLACE demonstrated such an effect with a sample of "black water" collected from a fire hydrant during flushing operations. The black suspension in the water was manganic oxide which had precipitated within the mains to accumulate out in the dead ends.

L. H. ENSLOW pointed out that some operators in testing for possible manganese interference had been testing for an error blank by taking samples ahead of chlorination. However, since manganese in the unoxidized manganous form, as usually found in water before chlorination or lime treatment, failed to give a color and after chlorination did so because of conversion to the oxidized form, it was wrong to make the error test on anything but the finished water. The simplest method of making the error blank determination was that of heating the sample to somewhere near the boiling point, cooling and testing for apparent residual. While the method should not be considered equal to the precipitation method of Standard Methods, it had proved very serviceable as an approximation, and erred on the safe side in determining the manganese deduction in chlorine dosage control or tap sample evaluations.

GEORGE R. TAYLOR, Scranton Spring Brook Water Co., Scranton, Pa., in commenting on bacterial tests said that he had found very little difference in results from examination of 500 cc samples (5 portions of 100 cc) and the older procedure of examining 5 portions of 10 cc. In his opinion more frequent and more representative sampling from the distribution system was needed, rather than the testing of larger volumes of fewer samples. Furthermore, sampling points should be selected on the basis of time of flow from the plant to consumers' taps, in order to have a full 24 hour history of the water in the system.

JOHN E. BELTZ, Consulting Chemist, Philadelphia, told of war experiences with dysentery of a real nature and the efficacy of the mobile "Sterilab" units, equipped with filter, chlorinator and laboratory, in definitely stopping the trouble. However, there was no attempt to economize in the treatment given.

E. C. TRAX, Plant Supt., McKeesport, Pa., said that he was always impressed with the ease with which most of the recorded waterborne outbreaks could have been prevented had a little more care been exercised.

PAUL MERKEL, City Chemist, Reading, Pa., in a prepared discussion pointed out that the literature on outbreaks which focussed suspicion on the local water supply had been inconsistent for the most part and confusing. He thought that a lack of dependable data before the outbreak, rather than much secured after the outbreak, left too much for speculation with too little actual fact finding. He felt that chlorination could be more effectively controlled on the whole, with due recognition of possible false residual chlorine test.

RICHARD B. HOAK, Distr. Engr, Pa. State Dept. of Health, who presented Mr. Merkel's discussion, said that he was of the opinion that water supply was being unfairly put on the spot unless more concrete evidence than had appeared was to be forthcoming.

R. I. DODD, Chemist, Chester Water Service Co., questioned the significance of the hard to kill 48 hr. gas formers because of the fact that so many consumers had been drinking them almost continuously without untoward effects. He was none the less an advocate of doing a constantly better job in respect to frequency of testing for residual chlorine and greater care in other plant operation procedures.

E. C. GOEHRING, Chemist, Beaver Valley Water Co., related an interesting outbreak of 55 cases and 4 deaths in the outskirts of Beaver Falls which gave the water company a scare, but was traced to a spring polluted after 60 years of use and a reputation of being the "finest water in Beaver Falls." Rather than take any chances he had chlorinated the reservoir to be on the safe side just as soon as the cases began to appear. He then told an interesting and hard to comprehend story, involving the local health-officer who refused to take prompt steps to condemn the spring because of its location just beyond the city lines.

HARRY J. KRUM, City Chemist, Allentown, Pa., reviewed 5 outbreaks of which he had knowledge, in one case the wells having been safe for 25 years previously and chlorination had been considered unnecessary.

GEORGE G. SCHAUT, Chemist, Philadelphia Water Dept., introduced the thought that these mild dysentery outbreaks might be due to chemical compounds entering the water seasonally from various vegetative growths. Such, for instance, was Mandrake (May Apple) which is known as "vegetable calomel" also the cyanogenetic plants yielding toxic glucosides.

At the close of the session I. M. Glace demonstrated the false residual chlorine test with ortho tolidin, for which manganese in the sample of black water collected during main flushing had been found responsible. The demonstration was to show that "good residuals" on the distribution system may not be residuals at all.

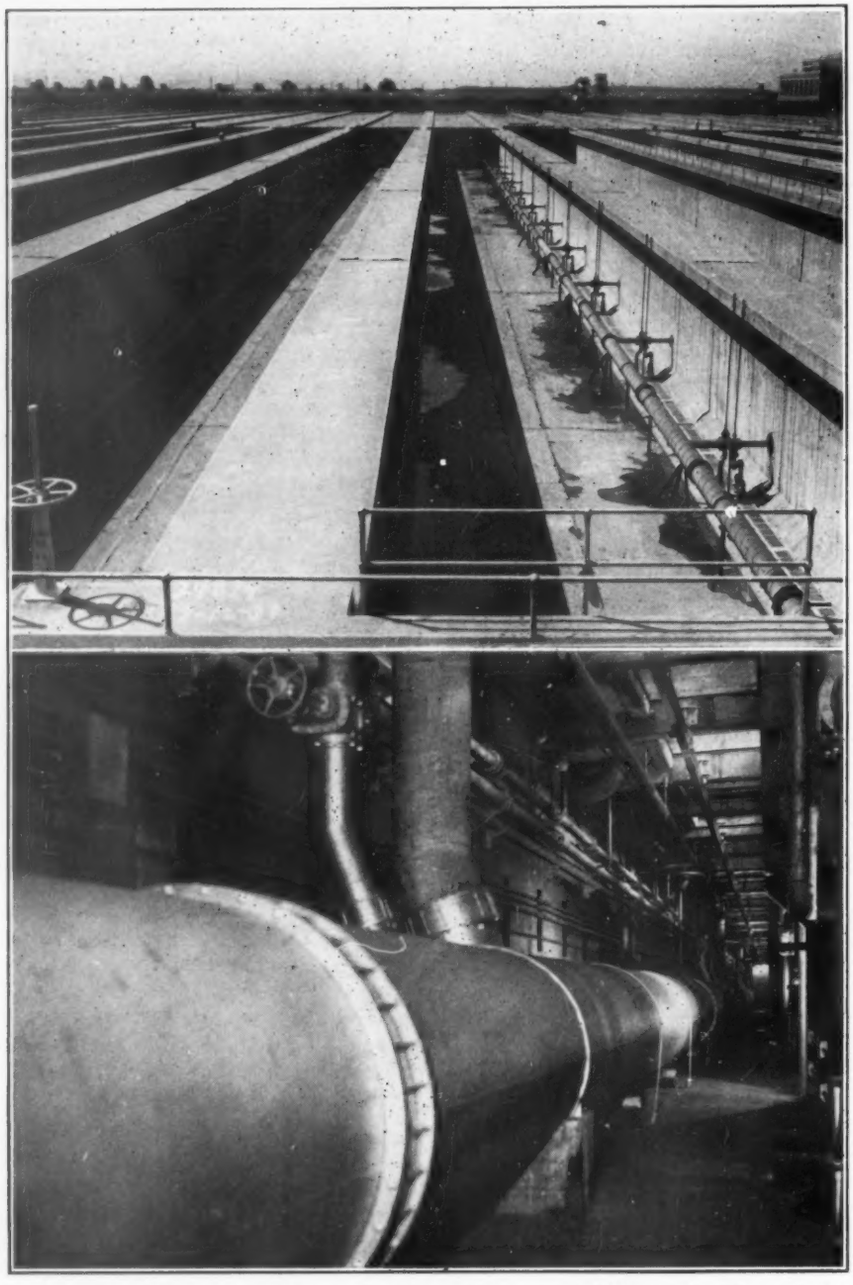
A DIGGING KINK*

In connection with water works and sewerage there is always much dirt digging to do—and much pick swinging. Here is what has proved to be a handy kink:

When there is insufficient room to swing a pick, remove the head of the pick and slip it into a pipe as indicated in the sketch. Your man is then ready to go ahead. In fact it is often worth while to make up a few "straight-line" picks of this kind and keep them always on hand ready for instant use. Your man can get into almost "any corner" with a pick of this kind.

*Contributed by W. F. Schaphorst, Newark, N. J.

DESIGNING AIR DISTRIBUTION SYSTEMS FOR ACTIVATED SLUDGE PLANTS



Spiral Weld Steel Air Piping, Throttling Valves and Diffusers in Two of the Four Bays of One Aeration Tank
(Each bay is 33' - 9" wide by 13' - 6" water depth.)
One of the 60-inch Air Mains Supplying One Battery of Tanks.
(Note long lengths jointed with Dresser type couplings serving as expansion joints.)

In our July issue appeared an article by Henry R. King, Senior Civil Engineer of The Sanitary District of Chicago, dealing with the design of air distribution systems for activated sludge plants.

In Mr. King's article many technical and economic aspects of design and construction of such air systems appeared for the first time in published form. Thereby, the results and conclusions developed from considerable study applied to this important feature in activated sludge plants have been made available to designing engineers and municipalities at large.

The pictures here reproduced were taken expressly for illustrating Mr. King's article but came to us too late to include with it. We, therefore, reproduce them so that those interested may see the type of construction employed in Chicago's newest plant — The Southwest Treatment Works—which will be the world's largest sewage treatment plant when completed.

SLUDGE BULKING AGAIN CORRECTED BY CHLORINATION*

What follows is not new, but since it is "Bulking Season" for Activated Sludge Plants we believe a recital of experiences with chlorine application at sewage plant of Flora, Ill., may prove timely as an added suggestion of at least one proven remedial measure for alleviating the undesirable phenomena of sludge bulking in hot dry periods.

Apparently Flora trouble was the most common variety of bulking, that accompanied by growth of filamentous organisms in the aeration units and the final settling tanks.

In other instances, wherein chlorination has proved beneficial, the chlorine has been added to the returned sludge only. In the case of Flora 5 p.p.m. (no residual) was applied continuously to incoming sewage, and none to returned sludge. Bulking condition improved within 24 hours, and within a few days sludge lifting was observed only during the period of peak flow.

Chlorine discontinued, bulking returned within a few days but was again brought under control with a recommencement of 5 p.p.m. chlorine application. The filamentous growths in the final tank cleared perceptably and functioning of the primary tank was again improved.

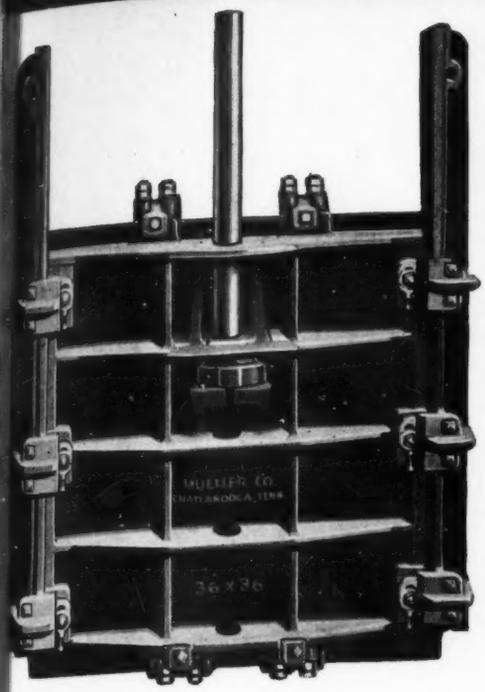
Discontinuance of chlorination caused an early return of sludge lifting in the primary tank and sludge loss from the final tank, justifying a return to chlorination until cool weather set in and chlorination was no longer needed to combat the effects of concentrated stale sewage.

On the basis of these experiences the following conclusions were drawn:

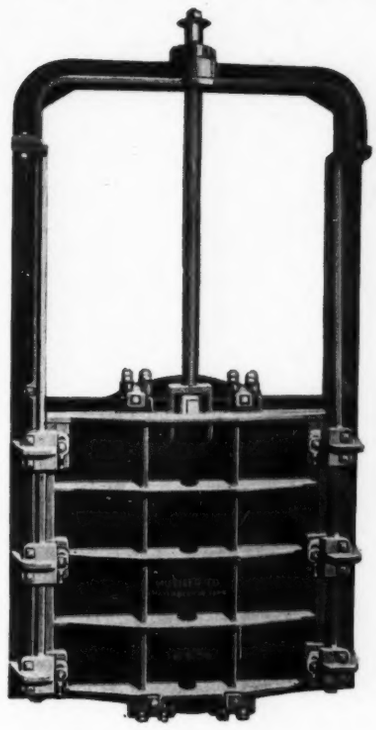
1. Severe bulking of sludge in the primary tank due to the presence of the thin branch-like filamentous growth was controlled successfully by chlorination of the raw sewage going into the plant.
2. Quicker recovery would probably have been shown had chlorine been applied to the return sludge as well as the raw sewage, since chlorination did control the filamentous growth.
3. Objectionable sewage odors were controlled by chlorination.
4. The cost of chlorination during periods when sludge bulking occurs is partially offset by the reduction in power savings.

*Based on a report by L. D. Hudson, Ass't. Engr., Ill. Dept. of Health, in **The Digester.**

SLUICE GATES



Many engineers find that they can fill their Sluice Gate requirements out of the Mueller-Columbian regular line. Sizes up to 96 by 96 inches are available and may be had with either circular or rectangular opening, rising or non-rising stem, and for either seating or un-seating pressure and to fit any type of connection. They may be operated manually, with hydraulic cylinder or by electrically operated floor stands. In cases where the regular line will not fulfill the requirements, Mueller-Columbian can offer experienced engineers and the finest facilities to produce equipment to exact specification.



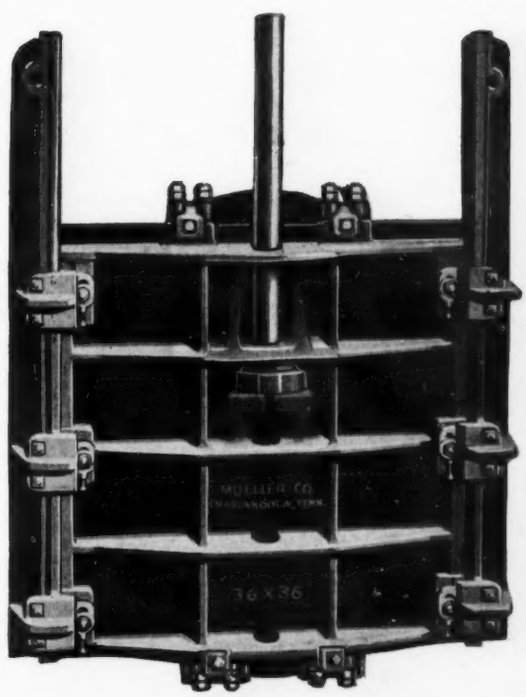
Get in touch with Mueller-Columbian before you specify. It may result in unusual savings. Recommendations, specifications, and estimates cheerfully given.

COMPLETE LINE

A complete line of water control equipment is manufactured by Mueller-Columbian including Sluice Gates, Floor Stands, Valves, Shear Gates, etc. Write for Catalog A-300 that shows the complete line as well as valuable engineering data.

FLOOR STANDS

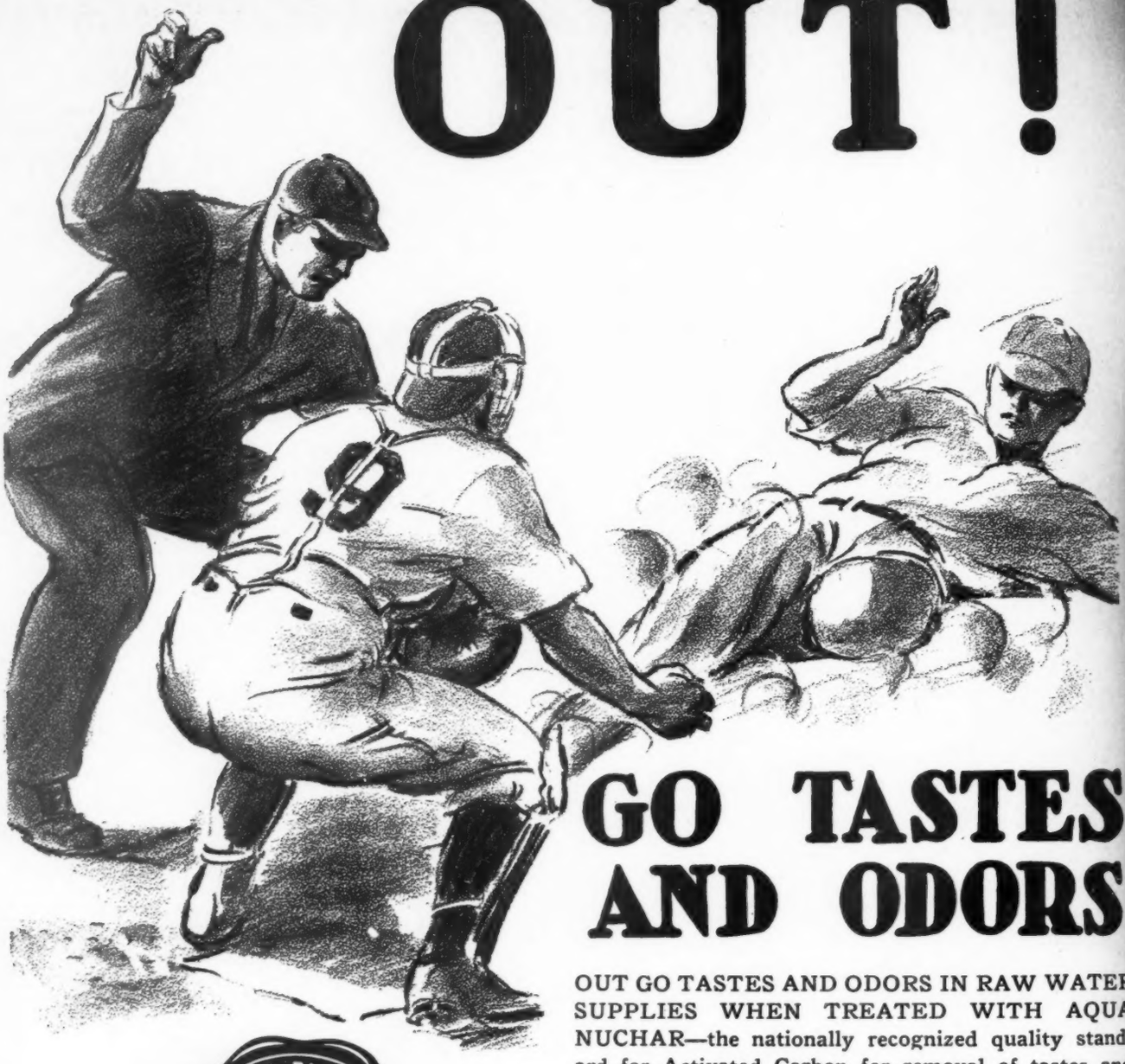
The line of Mueller-Columbian Floor Stands is most complete. They may be had with either rising or non-rising stem in plain or ball bearing type and with geared, two speed operation. For remote control, hydraulic cylinders or electrically operated stands can be furnished to meet practically any requirement.



MUELLER COLUMBIAN

WATER CONTROL EQUIPMENT

OUT!



GO TASTES AND ODORS

OUT GO TASTES AND ODORS IN RAW WATER SUPPLIES WHEN TREATED WITH AQUA NUCHAR—the nationally recognized quality standard for Activated Carbon for removal of tastes and odors to ensure a palatable drinking water.

More than 1100 water plants throughout the Country have endorsed AQUA NUCHAR as the most effective means of control. Information on its application is fully described in our booklet "Taste and Odor Control with Activated Carbon." A chart showing a method for measuring taste and odor in raw water supplies will be gladly mailed to you on application.

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W. W. HURLBUT writes:

LONG LIFE

This unretouched photo shows a section of America's oldest functioning cast iron water main, installed 118 years ago in Philadelphia. On such evidence rests cast iron pipe's title to the slogan, Public Tax Saver No. 1.

"In the high value district of Los Angeles, comprising approximately one square mile, there are 147,000 lineal feet (approximately 26 miles) of cast iron pipe in diameters 24", 20", 18", 16", 12", 10", 8", and 6". The oldest of this pipe, the 18", was laid forty-five years ago. The system is operated under seventy-five pounds pressure.

"The maintenance and repair costs for these twenty-six miles of distribution lines for the past ten years amounted to $143.00. Repairs were due to four breaks. This results in the low cost of 55¢ per mile per year."

W. W. Hurlbut

WATER mains represent about one-third of this country's 5-billion-dollar investment in public water supply systems. More than 98% of these mains are cast iron pipe with a *known* useful life at least double the *estimated* life of other water main materials. Because the tax-saving, through deferred replacements alone, is enormous, cast iron pipe is known as Public Tax Saver No. 1.

Look for the "Q-Check" Registered trade mark. Cast iron pipe is made in diameters from 1¼ to 84 inches.

SALVAGE VALUE

In Kenosha, Wisconsin, this 14" cast iron pipe was recently relaid after 43 years' service in its original location. Inspection showed it was good for generations of service in the new location.

DON'T OVER LOOK THIS IMPORTANT ISSUE!

THE SEPTEMBER ISSUE

OF

WATER WORKS AND SEWERAGE

Will Be Distributed

AT THE

New England Water Works Association
Annual Convention

To Be Held at the

HOTEL WINDSOR

MONTREAL, CANADA

SEPTEMBER 12 to 15, 1939

[And at 10 Additional Meetings Between September 15th and October 15th]

PLEASE NOTE:

Owing to the early date of this convention the advertising forms for our September issue will close in Chicago on Sept. 1, 1939 — complete plates can be accepted until Sept. 5, 1939, if proofs not required.

It will pay you to be in this widely distributed issue.

The Publishers

IOWA'S FAMED REGION OF LAKES GETS COMPREHENSIVE SEWAGE DISPOSAL SYSTEM

Built as a State Project With W.P.A. Assistance

By A. W. VON STRUVE
Chief of Data Section
Works Progress Administration
WASHINGTON, D. C.

IN northwest Iowa near the Iowa-Minnesota border is located the Hawkeye state's famed Great Lakes Region, which for years has been a popular vacation spot for thousands of visitors from every part of the nation.

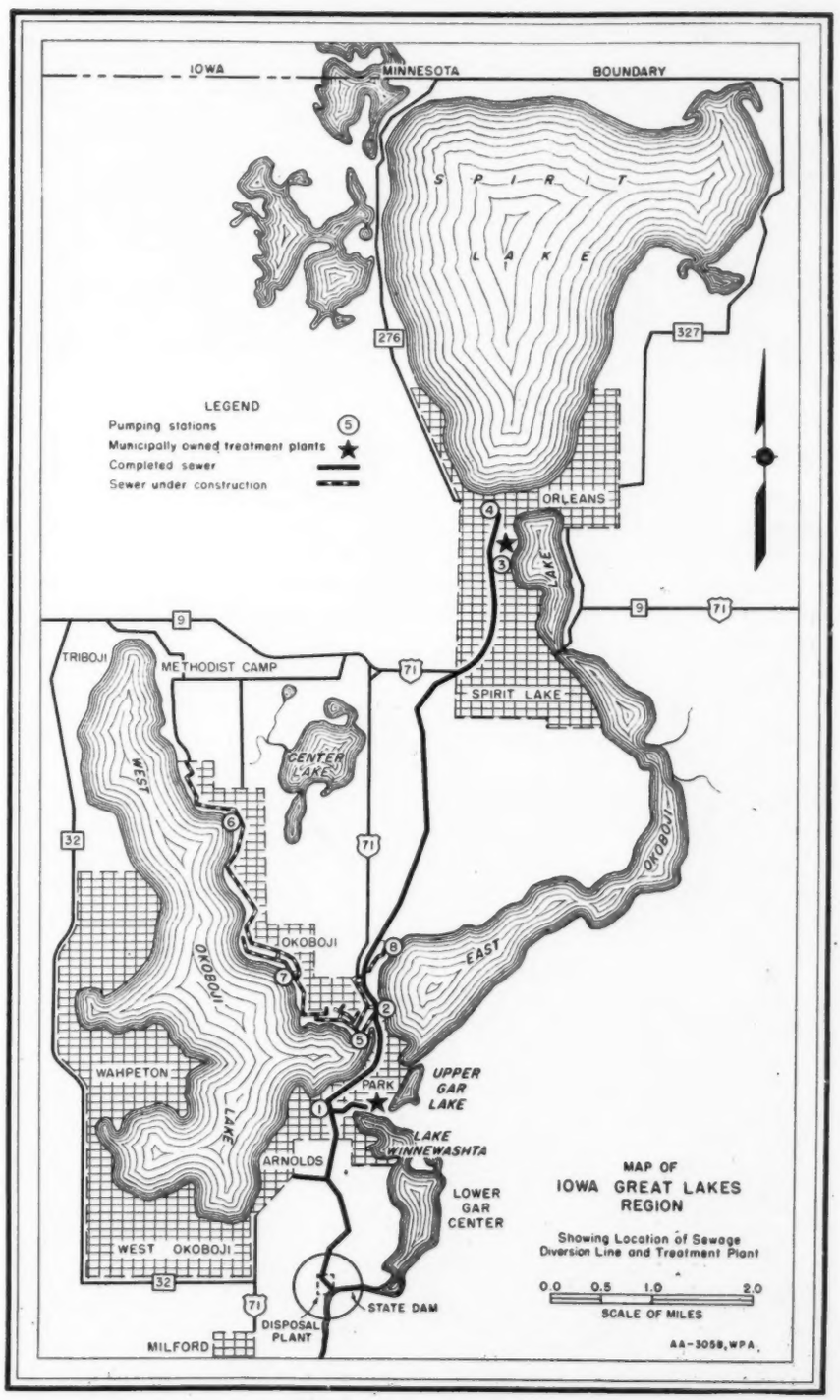
Prominent in history, as the scene of the Spirit Lake massacre of 1857 in which 42 whites were killed by a renegade Sioux Indian and his band, the lakes region during the past 82 years has developed into an important recreational area with its hundreds of cottages, summer camps and playgrounds.

West Okoboji Lake, second largest in the chain, is one of the few "blue water" lakes in the world. Unusual types of under water plants in the lake bed gives the water a bright biue color during the entire year. Spirit Lake, largest in the chain, nestles close to the Minnesota state border. The third largest lake is East Okoboji, a long narroy body of water connecting Spirit lake and West Okoboji Lake. (See accompanying map.) Other lakes in the region are Little Spirit, Minnewashta, Upper Gar and Lower Gar.

In recent years evidence of pollution has appeared in these lakes, due to the dumping of raw sewage into the waters. While the towns of Arnolds Park and Spirit Lake were treating their sewage in adequate plants before the effluent went into the lakes, but raw sewage from the resorts outside these two towns, however, appeared to constitute the major problem.

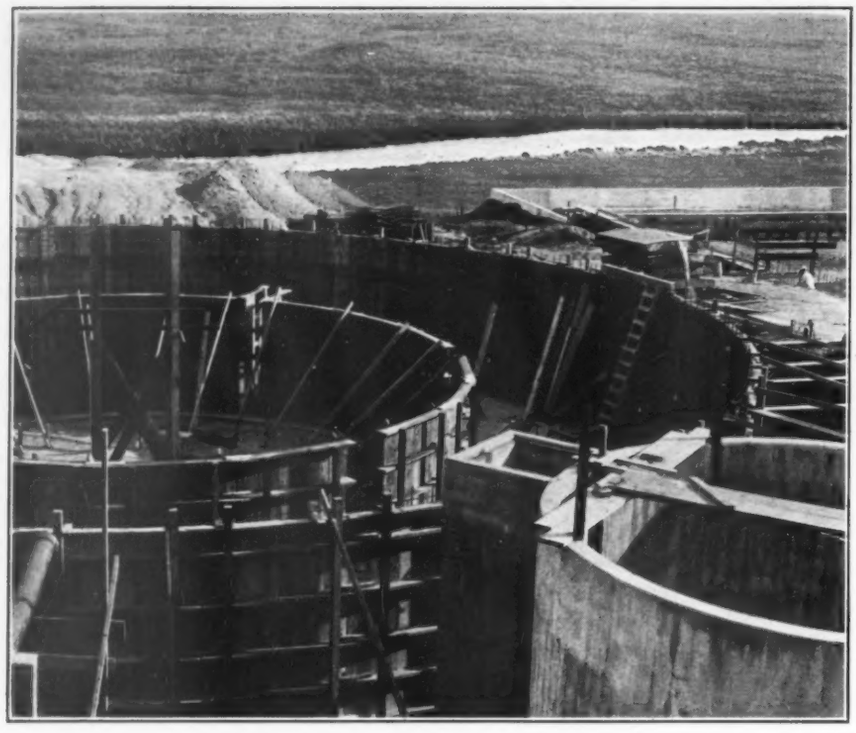
W.P.A. Assistance Asked—

Recognizing this pollution problem as an obligation of the entire state, the 1937 session of the Iowa legislature allocated state funds to the Iowa State Conservation Commission to sponsor the construction of an in-



Great Lakes Region of Iowa

(Showing Diversion Sewer, Treatment Plant and Lift Stations. The municipally-owned plants, starred, are being abandoned. All treatment will now be given at the new activated sludge plant discharging into Litle Sioux River.)



The Dorrco "Clareator" Under Construction
(An invention of one of the members of The Currie Engineering Co., designing engineers, is a combination unit providing aeration—outside ring—and final clarification—center tank. Right foreground—the base for the gas holder. Right background—the primary settling tank.)

tercepting sewer for collecting the sewage and a treatment plant to serve the whole area. Application for assistance from the Works Progress Administration to develop the project was promptly approved and funds were made available for the construction of the diversion line from Orleans on the south shore of Spirit Lake through the region to the proposed treatment plant, as shown on the accompanying map.

Construction of the long collecting and diversion sewer was begun late in 1937. All the activity was confined to that unit of the project until July, 1938, when erection of the treatment plant was started. Both units are now in operation in time for the 1939 summer season.

Tough Going and Deep
(A typical section through trees in front of cottages lining the lakes. Average depth of diversion sewer 14 ft., with 23 ft. trench at spots.)

Although the primary function of the trunk line is to divert the sewage from the municipal plants at Arnolds Park and Spirit Lake, it also makes possible the extension of sanitary facilities to other points along the various lake shores, which when accomplished will greatly reduce pollution at these lakes. One such lateral line, extending through the town of Okoboji along the northeast shore of West Okoboji Lake, is now under construction but will not be completed for use during 1939.

Four Lift Stations Required—

The trunk line, extending for a distance of 8.69 miles, is equipped with four pumping stations for lifting the sewage at such points so that it may flow by gravity to the next pumping location. Because this sewage must necessarily be pumped under considerable pressure, rising mains of cast iron pipe lead from each pumping station to the next high point. Approximately two miles of cast iron pipe, ranging from six to twelve inches in diameter were required for these force mains.

Vitrified clay pipe, ranging from ten to twenty-one inches in diameter, was used to build the 35,448 feet of gravity flow lines, the average depth of which is 14 feet. The maximum depth at one point, due to a rise of ground, is 23 feet. The ditch for the cast iron pressure line averaged eight feet deep. Scattered along the trunk line at distances not exceeding 800 feet are 84 manholes, required for maintenance and also future connections. Each manhole is approximately 5 ft. in diameter.

The Currie Engineering Company of Webster City, which was employed by the State of Iowa to handle the engineering design and construction details, had some unusual problems with which to contend when it planned the treatment plant into which all the sewage flows.

Seasonal Load Problems—

Because of the wide variation in the population of the lakes region during the winter and summer months, the treatment plant had to be designed to handle a varying flow of sewage. It is believed by the engineers that even during the summer seasons there will be a variation in the amount of sewage during weekdays and week-ends. As a result of this contemplated variation in flow, the equipment has been virtually designed in duplicate with only a por-

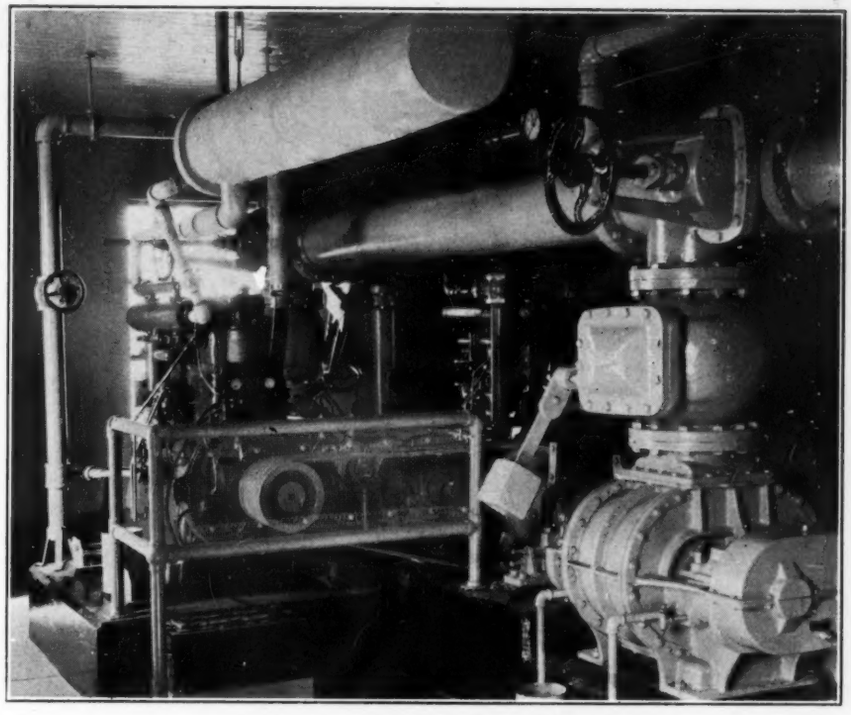
tion of it to be used during the winter months.

The treatment plant is of the compressed air activated sludge type. Only four other treatment plants in Iowa use this method of treating the sewage, the majority of plants being of the trickling filter type when secondary (oxidation) treatment is provided.

One of the most heavily populated areas in the lakes region will be served by the connecting line through the town of Okoboji, this line extends for 4.17 miles from the trunk line to the north limits of the corporation, while 2.47 miles of lateral branch lines feed into it.

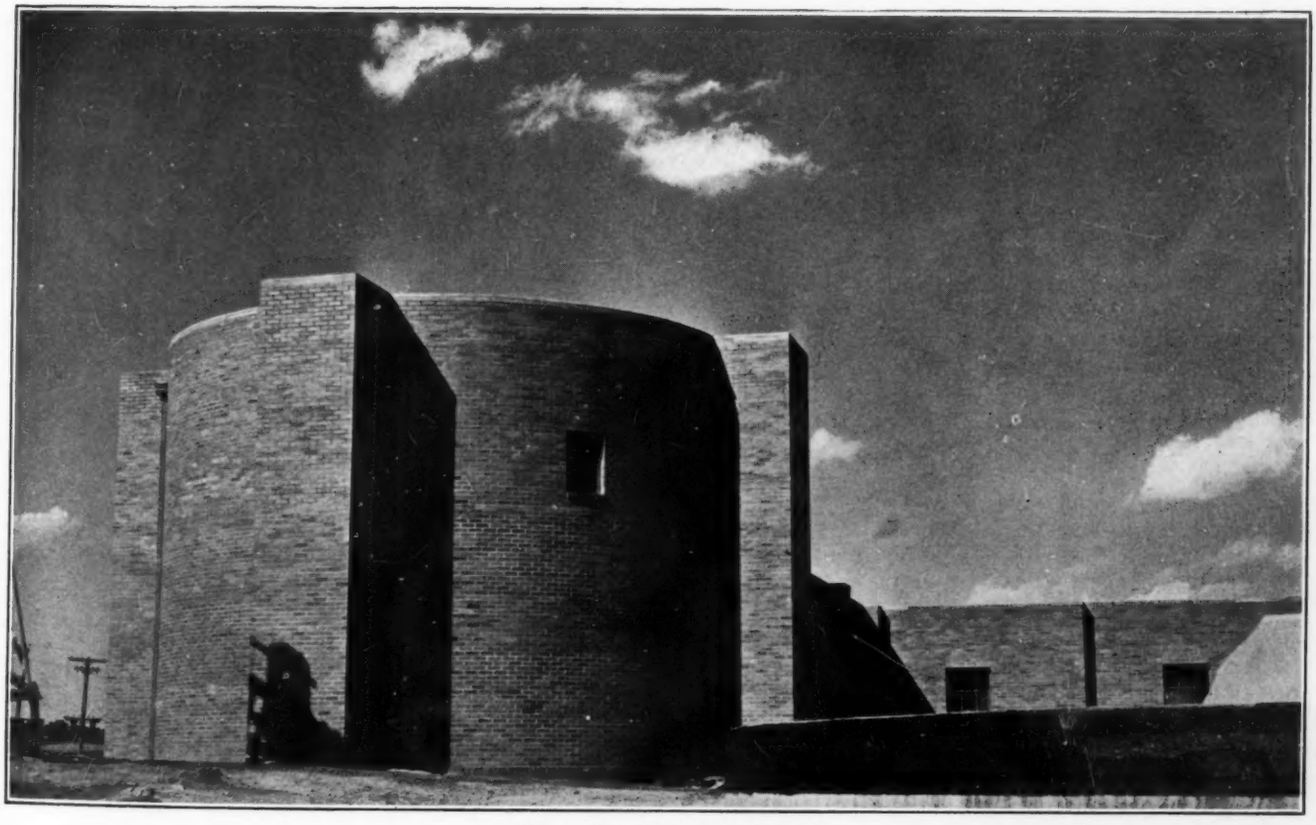
Irregular topography of the lake shore necessitated construction of the four pumping stations. At one point along the shore, a 5,800 foot gravity flow line is being installed to carry the sewage north to a pumping station from whence it will flow back south to the trunk line.

One hundred and fifteen manholes, each four feet in diameter, are located not more than 600 feet apart on the Okoboji town line. While the average cut for the ditches was only 11 feet, at several points the workmen had to excavate to a depth of 23 feet in order to obtain the proper grade. On this project as many as 668 were employed during the peak operations in the spring of 1938.



Sludge-Gas Engine and Air Blower
(Converts pollution into useful work at Iowa Great Lakes modern plant.)

Because the towns in the lake region could never have financed this splendid development, which is certain to safeguard the health of the thousands who visit the region each summer, it is fortunate that the federal government, through the medium of the Works Progress Administration, has been able to cooperate with those towns and the State of Iowa in securing these improvements.



Iowa Great Lakes Plant
(The heated sludge digester at close range.)

The Author

SLUDGE FILTRATION

Laboratory Control of Sludge Filtration

*[The Fourth Article in a Series]**

By LeROY W. VAN KLEECK
Senior Sanitary Engineer
Conn. State Dept. of Health
HARTFORD, CONN.

THE efficiency of sludge filtration can be enhanced, its cost reduced, and adequate records maintained with the aid of certain laboratory tests. The more important of these tests are determinations for specific gravity, solids, pH, and particularly Buchner funnel tests for filtering rates. Occasional observations of the color, turbidity and B. O. D. of filtrates are also desirable.

Specific Gravity — The specific gravity of the unconditioned sludge and ferric chloride solution should be determined occasionally. The manner of obtaining specific gravity figures and their application in filtration computations were discussed in paper No. II of this series (June, 1939) under "Computation of Amount of Chemicals Required for Filtration of Sludge."

Solids — Solids determinations should include the dry (total) solids in the unconditioned and conditioned sludge, filter cake, and filtrate. In addition, the suspended solids should be run on the filtrate from time to time. Directions for making solids determinations can be found in "Standard Methods for the Examination of Water and Sewage," American Public Health Association, New York City, or in any good laboratory guide book.

Samples of unconditioned sludge should be collected directly ahead of the conditioning facilities, but after sludge concentration if the latter is provided.

The conditioned sludge should preferably be collected at the outlet of the conditioning tank or from the pump or bucket discharge, when such are used, at the filter vat. While samples can frequently be taken from the filter vat directly, under some conditions, particularly with large vats or in vats where the agitators are not in constant operation, nonrepresentative samples may be obtained. This occurs because the heavier flocculated sludge may be at the center of the vat near the bottom, while at the ends of the vat or near the top there is a greater amount of sludge liquor.

The filtrate can be conveniently sampled from a cock on the discharge side of the filtrate pump.

Tests for solids should be made on composite samples rather than grabs. This applies particularly to sludges, less so for filtrates. The total solids in unconditioned and conditioned sludge are mainly of use in determining the chemical doses on a dry basis as explained in paper No. II of this series. The total solids in the filter cake are a measure of the efficiency of the vacuum filter, permit computation of the solids removed by the filter (filter yields), and serve as an index of considerable importance when the cake is incinerated. Wet sludge cake throws an additional load on incinerators.

The total and suspended solids in filtrates are of interest in checking the condition of the filter cloth and in showing the character of this liquor, which is generaly returned to the raw sewage for re-settling. The figures will generally run reasonably constant at a given plant—sudden jumps meaning holes in the cloth or changes in sludge conditioning. Conditioned digested sludge yields better filtrates than raw sludge. The total solids in raw sludge filtrates at Connecticut plants run about 0.7 to 1 per cent; suspended solids run 50 to 250 p.p.m. Digested sludge filtrates run about 0.2 to 0.5 per cent total solids and generally under 100 p.p.m. suspended solids. Suspended solids in digested sludge filtrate have run as low as 10 p.p.m. in some samples.

Color and Turbidity of Filtrates— A pronounced amber color in fresh filtrates indicates excess iron. High turbidity may indicate excess lime or holes in the filter cloth. In the latter case the total solids will also increase. These observations, as well as those for suspended solids, B.O.D. and pH, should be made on fresh samples held a minimum time. This, because of the character of some filtrates is subject to change due principally to the presence of iron.

B.O.D. of Filtrates—The B.O.D. of filtrates is primarily of theoretical interest. Usually it is under 2000 p.p.m. Figures below 500 and over 3500 p.p.m. have been obtained by the writer. Filtrates from the elutriated digested sludge at Hartford, Conn., have ranged only 67 to 140 p.p.m. of B.O.D.

It may be observed from the above figures for solids and B.O.D. that filtrates are far easier liquors to handle at sewage plants than digestion tank overflow liquor. As a matter of fact, filtrates should, theoretically at least, aid somewhat in the sedimentation process when returned to the raw sewage. Filtrates should, furthermore, serve as excellent diluents for sludge too heavy to filter, thereby utilizing the iron present in this liquor. Mohlman & Edwards have pointed out in such cases, however, that chlorine might be necessary to convert the ferrous iron back to the ferric state.

pH of Filtrates—The pH of filtrates is frequently useful as one of the control tests in sludge conditioning. Connecticut plants, conditioning with lime and ferric chloride, generally obtain a pH of 10.0 to 10.5 with well-conditioned sludge. The pH of the elutriated digested sludge at Hartford, using only ferric chloride for conditioning, has varied from 6.3 to 6.8. The pH should be determined on fresh samples. There are indications that when both lime and ferric chloride are used in conditioning it is wasteful to use more lime than is necessary to obtain the optimum pH for that particular sludge. A series of tests made recently by the writer on one sludge showed that large additions of lime failed to increase the pH appreciably above 10.4, once this value was

[For the inexperienced operator, "A Laboratory Manual for Chemical and Bacterial Analysis of Water and Sewage" by Theroux, Eldridge and Mallmann, McGraw-Hill Book Co., Inc., will be found more understandable and simpler to follow.]

*Other articles in this series by Mr. Van Kleeck on "Sludge Filtration" ran in March, June and July.—Editor.

reached, thus showing that the maximum ionization of the lime had occurred. *Since the filtering time for this sludge was not decreased by lime additions beyond pH 10.0 it is obvious that pH readings were of benefit in saving lime.* Similar applications may be true elsewhere.

The writer is not convinced, however, at this writing that pH tests can be used as an exclusive control for sludge conditioning. Conditioning can be based on actual filter operation coupled with the results of the Buchner funnel test.

The pH of the filtrate is also, of course, the pH of the filter cake. In the case of raw sludge cake, excess lime will retard putrefaction and odors, and pH tests will aid in cases where such control is attempted. The apparent influence of high pH values on the bacteria in sludge cake has been pointed out in paper No. III (July, 1939) under "Filter Cake As Fertilizer."

Instruments for recording pH, which are suitable for making pH tests of conditioned sludge or filtrate, are on the market. In some cases their purchase may be justified by improved filtering and the saving they may effect in ferric chloride and lime.

The Buchner Funnel Test

A bucket of the sludge to be tested is collected and 200 gram samples are used for each filtration test. If the sludge has already been conditioned, it should be agitated as little as possible and filtered immediately. If unconditioned, ferric chloride solution or lime, or both, are added to 200 grams of the sludge and the total amount of sample made up to 220 grams with distilled or tap water. This 20 gram limit above the 200 gram sludge sample permits using a wide range of coagulant dosages without changing the total weight of the filtered sample. *For practical work, where accuracy is not important, the make-up to 220 grams can be omitted.*

For accurate work the sludge samples are weighed in a beaker on a pan balance sensitive to 0.1 gram. For practical purposes a 200 cc. graduate can be used for measuring the sludge which is then poured into a beaker and no further measurements made. In tests for determining the amounts of conditioning chemicals required, the lime added to the sludge should be accurately weighed on a pan balance and the ferric chloride solution measured with a titration burette. A 10 or 20% solution is commonly used. Use of the plant stock solution of known strength simplifies the laboratory computations. In all tests, the contents of the beaker should be stirred in the same manner and for the same length of time after the addition of each chemical. This is commonly done with a hard rubber spatula or small wooden paddle for a period of about 30 seconds.

Modern Sewage Treatment Plant at New Britain, Conn.

Building houses vacuum filters with all appurtenances, sludge incinerator, a laboratory, office, chemical feeding apparatus and chlorinators for chemical precipitation of raw sewage, rest rooms, storage for carload lots of chemicals, and a basement containing miscellaneous equipment

The prepared sludge is poured into a 9 cm. Buchner funnel, wherein a wetted filter paper has already been sucked into position on the funnel's perforated bottom. The funnel rests in the neck of a standard suction flask connected with a water suction pump (aspirator) equipped with a vacuum gauge in the suction hose. The gauge indicates the pulling vacuum and is a means of indicating when the test is completed. The first drop of the mercury column or indicating pointer, as the case may be, is taken as the end point of the test.

As a substitution for the vacuum gauge, a piece of glass piping can be connected to the end of the Buchner funnel and extended to within a short distance of the bottom of the suction flask. The filtrate which accumulates during the testing will submerge the end. When the vacuum breaks, bubbles of air are released through the piping, indicating the end point. This method has been tried and used successfully at Baltimore and more recently at Hartford.

When the sludge is poured in the funnel, the aspirator and a stop watch are simultaneously started. When the sludge cake cracks or separates from the walls of the funnel, air passes into the suction flask, and the vacuum breaks. The time is noted.

A 12 cm. Buchner funnel can be used in place of the 9 cm. funnel in which case the filtering time should be about half that with the 9 cm. funnel. In some instances the larger funnel gives cake thicknesses on the filter paper more comparable to the plant filter cake. Or the 9 cm. funnel can be used and less than 200 cc. of sample filtered, so that the cake thicknesses in the funnel and on the filter drum are comparable.

Expensive filter paper is not necessary, but the same grade should be used throughout a series of tests. Left-over pieces of filter cloth can be cut to fit the funnel and used in place of paper. For some investigations the use of cloth is advantageous.

When desired, the weight of the cake can be determined by deducting the cc. of filtrate obtained during each test from the total cc. of sample filtered.

Interpretation of Funnel Tests

The sewage plant operator should tabulate or plot the amount of chemical added against the time for vacuum break, and thus arrive at the optimum dosages for his particular sludge. Table I illustrates the procedure.

TABLE I

Sample	$FeCl_3$ (C.C.)	Lime, (Grams)	Time for Vacuum To Break
1	0.5	1	+ 5 Min.
2	3.0	1	2 Min.-40 Sec.
3	5.0	1	1 Min.-20 Sec.
4	2.0	2	1 Min.-30 Sec.
5	1.0	3	2 Min.-10 Sec.

By making sufficient tests with varying amounts of coagulants the most economical doses, to obtain an optimum filtering time, can be determined. The maximum allowable time must be determined by each plant depending on the available drying time on the drums, the vacuum used and other variables. The following figures give some idea of the average limits:

More than 5 minutes under full vacuum in the funnel generally indicates a sludge that will filter poorly and cause blinding of the cloth; 3 to 4 minutes usually gives fair filtering results; 2 to 3 minutes is satisfactory; 1 to 1½ minutes is very good and is a desirable filtering time for plants where the sludge is held as in batch-mixing.

If the vacuum breaks in less than 1 minute and the chemical amounts can be further cut, this should be done, as such rapid filtering is not necessary for satisfactory operation with most vacuum filters. Generally an optimum chemical dose is required for every sludge, below which and frequently above which filtering time increases.

If the same strengths of lime and ferric chloride solution are used in the laboratory as are used in the plant, the relations in Table II will hold:

TABLE II

Amounts of Hydrated Lime and Ferric Chloride Required for Sludge Filtration Based on Laboratory Filtering Test

Hydrated Lime Powder		Ferric Chloride Solution	
Grams per 200 cc. of Sludge	Lbs. per 1000 Gals. of Sludge	CC. per 200 cc. of Sludge	Gals. per 1000 Gals. of Sludge
0.5	21	0.25	1¼
1.0	42	0.50	2½
2.0	84	1.0	5
3.0	125	2.0	10
4.0	167	3.0	15

And so on in the same relation

The approximate quantity of lime in lbs. per 1000 gallons of sludge may be obtained from the number of grams used per 220 cc. of sludge by multiplying the number of grams by *42*. The quantity of ferric chloride solution in gallons per 1000 gallons of sludge may be obtained from the cc. used per 200 cc. of sludge by multiplying the number of cc. by *5*. These factors apply, of course, only when dealing with the same sludge and the same strength of chemicals as will be used on a plant scale.

Equipment for Funnel Test

Table III gives a list of the equipment required for the Buchner funnel vacuum test. (See also illustration). This equipment can be purchased for approximately $13.00. In many cases plant laboratories will already be equipped with most of the necessary pieces. The prices are as quoted recently by one of the leading laboratory supply houses:

TABLE III

Equipment for Buchner Funnel Test

Quantity	Description	Cost
2	200 ml. cylinders, graduated	$1.60
3	400 ml. beakers, Griffin low form pyrex	.75
1	Buchner funnel, 9 cm., equipped with rubber stopper to fit suction flasks	2.05
2	Suction flasks, 1000 cc. capacity	2.90
1	Suction pump, aspirator	1.35
1	Vacuum gauge, dia. 2½ in.	1.35
1	T-shape brass connecting tube for ¼ in. bore rubber tubing	.35
6 ft.	Rubber pressure tubing, ¼ in. bore, 3/16 in. wall	1.00
1	25 ml. burette Geissler student grade	1.10
6 boxes	Filter paper, embossed, 9 cm. dia.	.78

Applications of the Funnel Test

Following are a few applications of the Buchner funnel test listed as worthy of the consideration of operators:

1. For checking the plant conditioned sludge before delivery to the filters. Blinded cloths can frequently be avoided by this check-up, and the test is particularly useful at batch-mix plants. In continuous-mix plants most of the trouble with conditioning of sludge occurs at the start of operation. The funnel test is a valuable check on the sludge before delivery to the filter vats.

2. The length of time a conditioned sludge can be safely held before filtering can be determined. Knowledge on this is of value at the batch-mix type of plants.

3. Trouble with filters can be located with greater ease. For example, the test will reveal if blinded cloth is the cause of filtration difficulty or sludge conditioning.

4. Variable mixing periods and the best manner of mixing for a particular sludge can be determined.

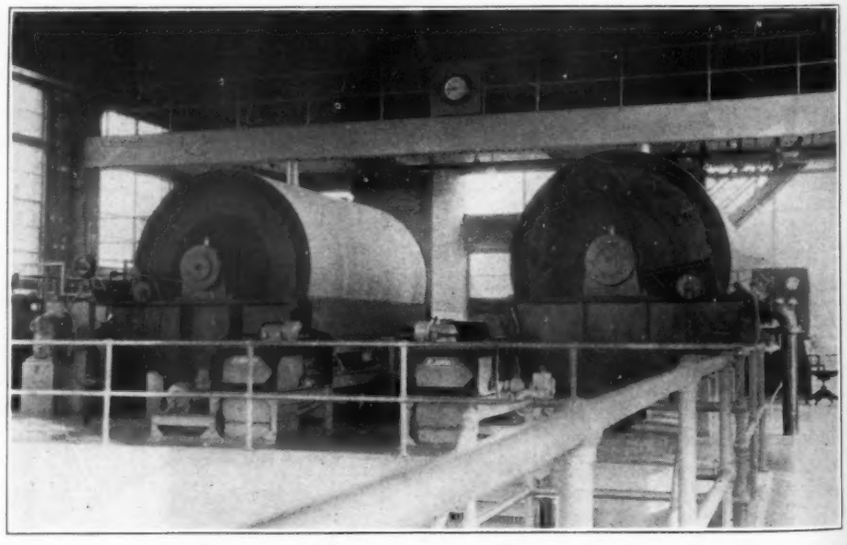
5. The order of addition of the chemicals and the desirable time lapse between additions can be checked.

6. Various commercial coagulants can be tried on the sludge at less cost and inconvenience than on a plant scale. Promising chemicals can then be given a plant trial.

7. Savings in ferric chloride or lime or both can frequently be shown by regular laboratory check-ups on sludge conditioning.

8. The filtrability and cost of sludge filtration at plants where sludge beds or centrifuges are now in use for dewatering can be determined. Funnel tests should be made on both summer and winter sludge.

9. Many miscellaneous experiments can be conducted, which might indicate the advantage of filter alterations, such as sludge concentration



Two Large Vacuum Filters at Hartford, Conn.
Ferris chloride storage vats show in upper right hand corner

Field Kit Containing all Necessary Apparatus for the Buchner Funnel Test
(See list in article)

facilities, elutriation, changes in sludge feed, etc.

Operators frequently report difficulty in preparing conditioned sludge in laboratory beakers that will check with sludge conditioned with the plant equipment. If a series of beakers are set up in such cases and various stirring times given sludge containing the same amounts of coagulants as the plant-prepared sludge, check tests can be made. The sludges are run through funnels including the plant sludge, and the sample which checks the plant sludge in filtering time is the one that has been similarly mixed. Future laboratory mixings can then be performed in a comparable manner.

Sometimes difficulty is experienced when using the funnel filtering time as a basis for anticipated results on the filters. Generally this is caused by differences in cake thickness or an exceptionally short or long drying period on the drums. The cake thicknesses in the funnel and on the drum should be made comparable and the drum drying time taken into consideration. *These and other discrepancies in the test can be eliminated if a particular plant set-up is carefully studied.* When properly performed and a record of the results are kept, Buchner funnel tests are well worth the time required for their performance.

Records for Filter Operation

Important steps in the process of sewage treatment are worthy of a daily record of operation. The following list of items is recommended for the daily log of a vacuum filter plant:

1. Gallons of filtered sludge.
2. Per cent of dry solids in the sludge (from a composite sample).
3. Per cent of volatile solids in the sludge (from the sludge obtained in 2).
4. Amount of ferric chloride, lime or other conditioning chemicals, reported in per cent on a dry basis.
5. The pH, suspended solids and total solids of the filtrate. (Made preferably on several fresh samples daily).
6. Total hours of actual filtering.
7. Pounds of wet filter cake.
8. Per cent moisture in filter cake.
9. Pounds of dry solids in filter cake.
10. Filter yield in pounds of dry solids per sq. ft. per hr.
11. If elutriation is employed, the solids in the unelutriated and elutriated sludge, and the suspended solids and occasionally B.O.D. of the elutriate should be reported.

Vacuum Filter Data on Four Types of Sludge

A summary of the operating results at four vacuum filter plants in Connecticut each handling a different type of sludge is presented in the following table:

FILTRATION DATA AT CONNECTICUT PLANTS

Item	*Plant A*	*Plant B*	*Plant C*	*Plant D*
Population Served	70,000	23,000	21,000	200,000
Av. Dry Weather Flow, M.G.D.	8.0	1.8	1.5	40.0
Type of Sludge Handled	Raw chemically precipitated	Raw primary	Digested primary	Elutriated digested primary
Sludge Conditioning Method	Continuous mix, gravity feed	Batch-mix, bucket feed	Batch-mix, pump feed	Continuous mix, gravity feed
Average Solids in Unconditioned Sludge, %	7-8	7	15	10-15
Avg., Volatile Solids in Sludge, %	65 to 70	70 to 72	35	30 to 35
Men Employed on Filters	1	2	2	2
Number of Filters	3	2	1	2
Total Filter Area, Sq. Ft.	600	113	94½	700
Filters Used at One Time, Normally	1	2	1	1
Filtering Cloth Used	Cotton, without nap	Cotton, without nap	Cotton, with nap	Wool
Hrs. from Cloth, Av.	350	250	250	—*
Avg. Operating Time of Filters Per Week, Hrs.	132	52½	7	32
Avg. pH of Filter Feed	9.0 to 10.5	10.5 to 12.0	10.0 to 10.5	6.3 to 6.8
Chemicals Used, Dry Basis				
Ferric Chloride, Avg. %	2½**	5½	2 to 3	1¾
CaO, Avg. %	12 to 13	12 to 16	6	None
Moisture in Cake, Avg. %	70 to 74	69	60***	63
Avg. Thickness of Cake	¼ in.	⅜ in.	⅜ to ½ in.	¼ to ⅜ in.
Lbs. Dry Solids Filtered, Weekly Avg.	104,650	7,600	4,000	70,000
Avg. Filter Rate in Lbs. per Sq. Ft. per Hr.	3.4	1.1	5.6	6.3

*Insufficient operating data to report cloth filtering hours at present
**A previous figure of 1½% has been reported for this plant. Recent filtering indicates, however, improved conditioning and a drier cake better suited for incineration with an increased dosage of chemical.
***Cakes as dry as 52% moisture have been obtained.

[The next and final paper by Mr. Van Kleeck will draw some comparisons between filtering raw and digested primary sludge, and will discuss some of the design considerations for future vacuum filter installations.—ED.]

OIL vs. COAL IN WATER WORKS OPERATION

By W. F. SCHAPHORST, M. E.
NEWARK, N. J.

AS THE years roll along and conditions and prices change, a question for the water works operator to consider again bobs up. "Shall we burn oil in place of coal? Or, shall we burn coal in place of oil?" It is hoped that this little article will be of some help in reaching the correct answer.

Herewith is a simple chart that shows at a glance which costs less in respect to heat values—oil or coal.

Dollar for Dollar Heat Values

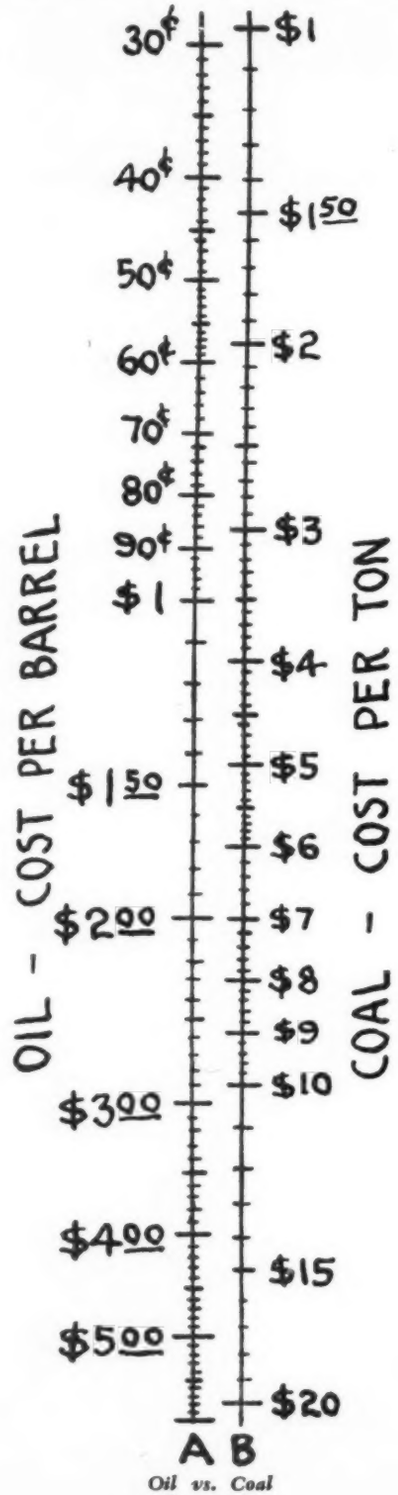
Let us suppose that oil in your vicinity costs $1.00 per barrel. Find $1.00 per barrel in column (A) and glance across to column (B), which shows that the equivalent is $3.50 per ton of coal. In other words if oil costs $1.00 per barrel and coal $3.50 per ton, it would very likely be uneconomical to switch from one to the other. But if coal costs more than $3.50 per ton, and you are now burning coal, it might pay to make a change. At least the cost of making the change and the advantages of oil burning over coal and vice versa then become worth investigating.

On the other hand, if you are now burning oil at $1.00 per barrel and you can buy coal at $2.00 per ton, or even $3.00 per ton, the cost of making a change and the difference in cost of operation will be worth investigating. The greater the difference in first cost the greater the money saving possibilities.

Other Factors:—

Before making a change, however, it is necessary to consider other factors involved, in addition to cost of fuel. Thus, what will the oil burning equipment cost? Storage tanks? Piping? You can obtain such costs from the manufacturers of the equipment. Is it likely that oil and coal prices will continue at present levels? What is the approximate life of oil burning equipment? In other words, depreciation, and interest on the investment should be considered.

Oil burning possesses several advantages over coal, among which are: less time is required to start the fire; oil fire can be shut off instantly; oil fires need not be pulled; nor need they be banked; there are no ashes to remove or handle; no investment in ash handling equipment; oil is fired mechanically, reducing the cost of labor considerably; oil pumps are simpler and less space consuming than stokers, ash handling machinery, etc., then, too, oil burning boilers are more efficient than coal burning boilers, and oil properly burned is smokeless.



Oil vs. Coal Value Scale

More or less counterbalancing the advantages of oil burning we have unreasonable laws and stringent ordinances governing the storage and burning of oil in some of our cities; it costs less to store coal; coal does not leak and can, therefore, be dumped upon the ground and stored without special facilities; coal can be hauled in almost any vehicle; coal does not evaporate; coal need not be preheated before burning; coal purchasing contracts can usually be extended over a longer period of time; and there is less hazard from coal burning.

All of the above points should be given careful study before deciding upon making a change from coal to oil, or from oil to coal. As is generally true of anything that must be purchased, first cost is less important than ultimate cost. The vital question is: Which will be more economical in the end? The question cannot be answered without taking many facts into consideration, but, as an indicator of comparative values for first consideration this chart has proved helpful.

PRESIDENT OF BRITISH WATER ENGR'S. TO ADDRESS N.E.W.W.A. Program Highlight of Montreal Convention

The highlight of the technical program of the New England Water Works Association's Annual Convention in Montreal, September 12-15, inclusive, will be the paper by John Bowman, City Engineer of Edinburgh, Scotland.

Mr. Bowman who is a member is a member of the Institution of Civil Engineers and this year President of the British Institution of Water Engineers will speak on "Waterworks Practice in England." His remarks will be discussed by the following eminent engineers: William Storrie, of Toronto; Caleb Mills Saville, of Hartford, Conn.; Robert Spurr Weston, of Boston, Mass., and Thomas H. Wiggin of New York City.

BETTERING THE TREATMENT OF THE SEWAGE OF NEW BRITAIN CONN.

Results With the Guggenheim Process Stepped Up

By JOHN R. SZYMANSKI
Plant Superintendent
NEW BRITAIN, CONN.

NEW BRITAIN, Connecticut, in 1936 stepped forward and decided to handle its industrial and domestic waste in a scientific manner by constructing a modern mechanical sewage treatment plant. The Guggenheim Bio-chemical Process was chosen after an effective demonstration for a sufficient period with a pilot scale plant.

By January, 1937, a plant designed to treat nine million gallons of sewage daily was ready to be put into operation. The plant was specifically designed to employ the bio-chemical process which involves air blowing aided by iron coagulant and sludge recirculation. It consists of coarse bar screens, primary settling tanks, dosing tanks, aeration tanks, final settling tanks, vacuum filters and a multi-hearth furnace. There also were provided adequate chemical feed machines and standard auxiliary equipment.

Effluent Standards Set and Met—

From various stream surveys and other determinations the State Waterway Commission decided that in order to be satisfactory, the effluent produced by the New Britain plant must have 30 p.p.m. or less of suspended solids and 50 p.p.m. or less of a 5-day oxygen demand. With the stipulated standards in mind, the first objective was that of producing an effluent meeting the above requirements consistently; next, to produce this effluent as economically as possible.

Although the usual "breaking in" difficulties were encountered, our troubles were ironed out in due order and after proper training of the personnel smooth operating conditions have prevailed since. Very little trouble was experienced in producing a satisfactory effluent and the next step was to reduce the costs. With this accomplished, and having evolved the best overall method of producing a satisfactory effluent economically it was decided to operate the plant on a routine basis, employing the program developed in the tuning up and test stages as that most economical to meet requirements.

The author

Due to the flexibility of the process, its ability to withstand sudden shocks of industrial waste, productive of radical variances of pH values of the plant influent throughout a typical operating day, much time and money was being saved by the above mentioned set standard of operation. For a period of more than a year the plant operated in this manner and, from careful observation and actual operating data it was evident that the process could give higher degrees of purification by spending more money for increased chemical dosages.

Putting the Plant to Further Test—

As a result of the above observations, it was decided to test the possibilities of the plant and process.

All conditions were favorable. First, the operating staff consisted of men who had better than two years of actual operating experience with the process and who had been receiving instructions in the mechanics of the entire plant at weekly meetings. Second, numerous analytical figures could now be intelligently interpreted and applied practically. Third, various trends showed that better results could easily be obtained if the treatment was watched a bit more carefully than it had been. Fourth, the actual capacities and retention periods and mechanical abilities of the equipment were known.

The accompanying tables have been arranged so as to give the reader a thorough picture of the work accomplished at the plant during the months of December, 1938 through May, 1939, as compared with the results the previous year. All analytical data are based on results ob-

Summary†

Month	Flow (m.g.d.)	Suspended Solids Raw	Suspended Solids Eff.	B.O.D. (5-day) Raw	B.O.D. (5-day) Eff.	Coagulant Fe. (p.p.m.)	Coagulant Cost (per m.g.)
Jan. '38	8.80	133	33	140	38	2.5	$1.32
Feb. '38	9.10	132	28	121	29	2.9	1.54
Mar. '38	8.65	144	30	145	37	3.9	1.91
Apr. '38	8.56	166	29	138	37	4.97	2.06
May '38	8.36	161	31	116	35	5.10	2.42
Dec. '38	10.37	133	16	122	28	3.3	1.58
Jan. '39	9.16	134	12*	141	29*	4.0*	1.95*
Feb. '39	10.23	157	6	164	13	4.5	2.18
Mar. '39	12.19	138	10	138	13	4.2	2.00
Apr. '39	12.77	140	8	141	12	3.1	1.45
May '39	9.74	166	12	179	18	5.2	2.31

* Increase in coagulant dosages began in January, 1939, but ultimate benefits not observed until late in month.

† For day by day results see accompanying detail records.

tained from twenty-four hour composites consisting of hourly samples proportioned to the flow at the time of sampling.

It will be noted that the consumption and cost of coagulant used in 1939 are somewhat higher than those of the preceding year, since the chemical dosage was purposely increased during these months. In conjunction with the increased chemical dosage the air lift for returning a small portion of the primary tank effluent was used during 1939 and not in 1938. This tended to modify the extra

FEBRUARY

Date	(1938) Susp. Solids Air	Raw	Eff.	Mixed Liquor	5-Day B.O.D. Raw	Eff.	Date	(1939) Susp. Solids Air	Raw	Eff.	Mixed Liquor	5-Day B.O.D. Raw	Eff.
1	.15	147	28	1410	133	30	1	.14	106	4	1088	175	17
2	.14	102	29	686	90	31	2	.16	292	5	1056	135	22
3	.15	102	28	1192	103	28	3	.15	140	6	1042	195	17
4	.15	130	31	1470	133	25	4	.15	124	9	992	170	13
5	.15	133	36	1360	65	12	5	.16	132	5	784	170	12
6	.13	146	23	1078	105	15	6	.16	162	9	880	135	10
7	.13	139	30	1184	118	31	7	.16	196	11	1000	183	16
8	.14	108	16	1160	113	22	8	.15	164	4	846	208	11
9	.14	76	26	1648	85	23	9	.16	176	3	960	105	5
10	.15	107	31	1460	90	16	10	.15	140	5	1000	135	11
11	.15	97	23	1392	123	37	11	.15	180	3	1020	200	14
12	.16	124	34	1406	75	29	12	.16	186	2	1068	225	11
13	.14	109	28	1196	100	21	13	.16	170	3	1080	278	16
14	.13	121	33	1144	215	50	14	.16	154	4	1064	170	8
15	.14	170	38	1328	163	38	15	.14	144	10	1128	120	14
16	.14	98	35	1244	118	40	16	.15	132	7	1376	213	18
17	.13	145	36	1296	150	16	17	.15	192	3	1280	165	16
18	.15	132	29	1270	115	25	18	.15	106	7	1156	118	6
19	.16	104	27	1260	198	36	19	.16	192	2	808	125	3
20	.16	118	24	1144	108	23	20	.15	154	12	1064	138	17
21	.16	210	19	1018	170	50	21	.15	176	6	1016	110	12
22	.15	220	30	1322	195	45	22	.15	144	4	924	148	18
23	.16	224	49	1350	148	36	23	.15	156	8	812	195	16
24	.16	144	28	1414	93	37	24	.15	142	3	940	123	16
25	.16	129	25	1102	185	29	25	.16	214	4	1072	273	13
26	.17	142	18	1140	68	20	26	.14	98	12	1200	83	8
27	.16	87	15	1226	50	14	27	.15	102	12	1160	173	8
28	.15	119	19	1242	88	27	28	.14	108	11	1072	115	11
Average	.15	132	28	1259	121	29	Average	.15	157	6	1032	164	13

FEBRUARY

Date	(1938) Flow (MGD)	Fe (PPM)	$FeSO_4$ (Lbs.)	+Cl (Lbs.)	Ferrisul (Lbs.)	Cost $	Date	(1939) Flow (MGD)	Fe (PPM)	$FeSO_4$ (Lbs.)	+Cl (Lbs.)	Ferrisul (Lbs.)	Cost $
1	9.0	2.6	976	182	.....	12.12	1	9.04	5.2	.....	.....	1530	22.65
2	9.3	3.3	1292	170	.....	14.06	2	9.02	3.8	.....	.....	1080	15.98
3	9.8	1.5	596	206	.....	10.05	3	10.95	3.8	.....	.....	1360	20.13
4	8.9	1.8	664	174	.....	9.65	4	11.43	4.8	1880	266	.....	20.98
5	9.3	2.2	856	186	.....	11.37	5	8.49	5.1	1800	226	.....	19.29
6	9.9	3.3	1352	188	.....	15.00	6	8.56	4.3	1540	174	.....	15.95
7	10.6	2.0	888	192	.....	11.76	7	8.26	5.5	1880	222	.....	19.76
8	9.5	1.7	680	180	.....	9.92	8	9.52	4.4	1760	244	.....	19.50
9	9.3	2.5	984	168	.....	11.78	9	8.43	4.2	1480	218	.....	16.76
10	9.0	2.4	904	198	.....	12.05	10	10.00	3.6	1500	200	.....	16.40
11	9.1	2.6	904	198	.....	12.05	11	9.17	3.9	1500	198	.....	16.34
12	9.0	2.3	856	190	.....	11.48	12	8.57	3.6	1300	204	.....	15.06
13	9.6	1.4	576	148	.....	8.29	13	8.93	6.7	2500	354	.....	27.90
14	9.5	2.7	1052	416	.....	19.20	14	8.61	3.5	1250	204	.....	14.71
15	9.5	7.4	2940	200	.....	26.77	15	12.90	2.0	1100	178	.....	12.90
16	9.5	3.7	1460	206	.....	16.28	16	10.55	4.1	1800	262	.....	20.29
17	9.3	3.6	1408	220	.....	16.30	17	10.06	5.2	2200	304	.....	24.34
18	9.2	2.5	952	172	.....	11.67	18	10.31	6.0	2600	315	.....	27.54
19	8.4	3.3	1152	182	.....	13.37	19	9.93	6.3	2590	336	.....	28.05
20	8.3	2.9	1004	206	.....	13.00	20	11.79	6.0	2930	296	.....	29.38
21	8.4	1.5	528	168	.....	8.51	21	11.36	2.9	1360	152	.....	14.05
22	9.1	3.8	1460	254	.....	17.64	22	10.95	4.7	2140	246	.....	22.29
23	8.5	1.6	80	114	*	16.68	23	10.53	5.0	2195	224	.....	22.08
24	8.6	4.5	.....	.....	1300	19.23	24	10.42	4.8	2090	216	.....	21.10
25	8.5	4.2	.....	.....	1200	17.77	25	9.82	4.5	1850	152	.....	17.57
26	8.1	3.7	.....	.....	1010	14.95	26	13.78	3.3	1880	208	.....	19.36
27	8.7	3.7	.....	.....	1060	15.68	27	10.71	4.2	1888	254	.....	20.72
28	9.4	3.3	.....	.....	1070	15.83	28	14.35	1.8	1304	200	.....	14.98
Average	9.10	2.9	1075	195	1200	14.05	Average	10.23	†4.5	1851	234	1323	†$22.31

* 300 lbs. of anhydrous ferric chloride.
Chemical cost per m.g. = $1.54.

† Include additional 1600 lbs. of anhydrous ferric chloride used.
Chemical cost per m.g. = $2.18

heavy shocks of industrial waste ahead of the secondary treatment.

From a practical standpoint, the air consumption of approximately fifteen one hundredths (0.15) of a cubic foot per gallon of sewage treated has been unchanged since the beginning of plant operations. Together with the two details men-

MARCH

Date	(1938) Susp. Solids Air	Raw	Eff.	Mixed Liquor	5-Day B.O.D. Raw	Eff.	Date	(1939) Susp. Solids Air	Raw	Eff.	Mixed Liquor	5-Day B.O.D. Raw	Eff.
1	.16	170	32	1184	138	32	1	.14	112	13	1516	128	15
2	.15	127	35	1266	163	35	2	.14	102	4	1240	120	16
3	.16	128	27	1129	143	34	3	.14	170	3	1004	110	20
4	.16	132	21	1212	118	25	4	.16	190	5	1140	168	18
5	.15	141	39	1300	93	41	5	.15	98	6	980	85	16
6	.16	102	34	1144	163	21	6	.14	206	10	1072	130	13
7	.15	144	44	1398	145	48	7	.14	102	11	1040	115	14
8	.16	219	37	1172	265	40	8	.15	134	7	1096	98	4
9	.17	125	35	1066	90	37	9	.14	82	4	1204	130	7
10	.17	84	44	1202	150	44	10	.14	128	13	1104	125	12
11	.17	141	35	1098	148	41	11	.15	152	11	1076	145	13
12	.19	131	31	956	165	45	12	.15	102	10	924	93	11
13	.17	102	30	1026	155	37	13	.14	158	10	1028	138	9
14	.16	171	35	1126	140	35	14	.15	154	10	1076	150	16
15	.16	172	21	976	155	38	15	.14	146	16	990	110	4
16	.15	132	30	902	95	34	16	.13	102	14	1008	88	13
17	.15	129	37	1130	108	34	17	.13	152	15	1020	143	12
18	.15	120	27	1042	110	40	18	.15	90	12	1416	128	11
19	.17	118	32	1014	100	26	19	.14	91	9	1384	153	11
20	.17	102	26	1146	160	27	20	.14	134	10	1048	170	12
21	.14	123	46	1122	135	35	21	.13	128	8	1060	200	9
22	.15	116	17	1263	155	26	22	.14	127	7	808	167	15
23	.14	101	21	840	188	48	23	.15	202	11	1024	160	12
24	.16	301	13	1000	160	42	24	.14	150	9	1248	173	14
25	.16	150	21	1150	170	33	25	.13	206	8	1432	153	16
26	.16	114	26	1178	90	36	26	.13	108	6	1174	155	14
27	.17	111	23	1072	178	39	27	.12	141	12	1138	110	12
28	.15	198	29	942	175	41	28	.10	162	11	1102	148	16
29	.15	142	33	678	150	47	29	.12	242	10	1232	220	16
20	.15	118	24	628	145	36	30	.13	102	14	1100	100	11
31	.15	291	31	908	133	45	31	.12	100	11	1206	158	14
Average	.16	144	30	1073	145	37	Average	.14	138	10	1125	138	13

MARCH

Date	(1938) Flow (MGD)	Fe (PPM)	$FeSO_4$ (Lbs.)	+Cl (Lbs.)	Ferrisul (Lbs.)	Cost $
1	8.8	3.8	.....	.....	1100	16.28
2	9.5	3.5	.....	.....	1120	16.58
3	8.9	3.8	.....	.....	1120	16.58
4	8.7	3.8	.....	.....	1100	16.28
5	9.4	3.4	.....	.....	1070	15.83
6	8.6	3.0	.....	.....	863	12.79
7	9.0	3.1	.....	.....	930	13.77
8	8.6	3.6	.....	.....	1020	15.09
9	8.4	3.6	.....	.....	1020	15.09
10	8.3	3.7	.....	.....	1020	15.09
11	8.1	3.8	.....	.....	1020	15.09
12	7.5	4.1	.....	.....	1020	15.09
13	7.1	4.7	.....	.....	1120	16.58
14	8.1	4.1	.....	.....	1120	16.58
15	8.5	3.9	.....	.....	1120	16.58
16	9.5	3.5	.....	.....	1120	16.58
17	9.4	3.6	.....	.....	1120	16.58
18	9.3	3.6	.....	.....	1120	16.58
19	8.3	3.8	.....	.....	1065	15.76
20	8.1	4.1	.....	.....	1120	16.58
21	9.9	3.4	.....	.....	1120	16.58
22	9.2	4.8	.....	.....	1465	21.67
23	9.2	3.7	.....	.....	1120	16.58
24	8.6	5.3	.....	.....	1510	22.35
25	8.5	4.0	.....	.....	1120	16.58
26	8.5	4.0	.....	.....	1120	16.58
27	8.2	4.1	.....	.....	1120	16.58
28	8.5	4.0	.....	.....	1120	16.58
29	8.5	4.0	.....	.....	1120	16.58
30	8.2	4.8	.....	.....	1320	19.53
31	8.9	3.8	.....	.....	1120	16.58
Average	8.65	3.9			1115	16.50

Chemical cost per m.g. = $1.91

Date	(1939) Flow (MGD)	Fe (PPM)	$FeSO_4$ (Lbs.)	+Cl (Lbs.)	Ferrisul (Lbs.)	Cost $
1	12.36	2.6	1280	206	.....	14.98
2	13.77	2.0	1120	190	.....	13.38
3	13.00	4.0	2100	334	.....	24.47
4	8.33	3.4	1100	188	.....	13.19
5	10.74	3.2	1400	188	.....	15.34
6	13.66	2.2	1140	160	.....	12.70
7	12.31	3.0	1490	186	.....	15.93
8	9.93	2.7	1020	140	.....	11.25
9	11.43	6.4	2950	226	.....	27.55
10	11.06	10.0	4120	310	.....	41.17
11	10.47	6.4	2760	256	.....	27.03
12	9.83	10.0	4120	310	.....	38.28
13	10.67	8.0	3575	294	.....	33.95
14	9.82	7.7	3175	240	.....	29.55
15	12.96	2.4	1275	148	.....	13.31
16	13.40	2.7	1500	164	.....	15.39
17	13.27	3.7	2030	182	.....	19.71
18	10.69	3.5	1580	180	.....	16.42
19	11.34	3.2	1494	162	.....	15.28
20	11.22	3.6	1600	194	.....	16.95
21	13.48	3.8	2176	226	.....	22.00
22	11.85	4.2	2076	194	.....	20.38
23	10.96	4.0	1820	176	.....	18.03
24	11.97	3.6	1819	166	.....	17.74
25	12.74	2.8	1500	130	.....	14.44
26	12.98	4.6	2500	180	.....	23.03
27	14.88	3.4	2100	160	.....	19.60
28	15.74	2.8	1870	180	.....	18.50
29	14.32	3.6	2163	191	.....	20.93
30	13.78	3.3	1880	184	.....	18.68
31	14.92	4.0	2500	230	.....	24.44
Average	12.19	4.2*	2049	203		23.35

*Includes an additional 2100 lbs. of anhydrous ferric chloride.

Chemical cost per m.g. = $2.00

tioned above, closer supervision was given to the actual chemical dosing of the sewage. The dosing was varied by periods with the changing incoming load. In checking the time spent on this extra supervision it was discovered that it would not require too much extra time hence it did not increase the costs for operating per-

APRIL

Date	(1938) Susp. Solids Air	Raw	Eff.	Mixed Liquor	5-Day B.O.D. Raw	Eff.	Date	(1939) Susp. Solids Air	Raw	Eff.	Mixed Liquor	5-Day B.O.D. Raw	Eff.
1	.15	196	37	1086	143	40	1	.12	112	13	910	130	12
2	.17	124	30	1098	85	28	2	.11	154	9	1096	90	10
3	.18	296	32	850	213	28	3	.12	105	4	1480	183	13
4	.18	172	28	1206	170	37	4	.13	100	3	1160	90	12
5	.16	161	27	1134	168	44	5	.13	110	6	1148	175	17
6	.17	199	33	970	230	33	6	.10	120	8	1006	150	15
7	.17	138	27	1096	115	45	7	.12	124	4	1088	153	16
8	.15	101	36	1006	153	34	8	.13	126	8	1110	103	9
9	.16	139	32	942	148	30	9	.15	110	8	1134	185	14
10	.14	170	23	820	137	24	10	.12	155	8	1254	178	14
11	.14	194	19	806	185	40	11	12	168	10	1400	133	16
12	.15	149	28	841	133	34	12	.14	120	12	948	138	13
13	.14	160	58	1048	163	50	13	.13	100	11	1400	170	10
14	.14	131	48	1432	123	41	14	.13	144	6	916	113	12
15	.14	172	38	1122	93	45	15	.14	136	5	1012	130	16
16	.17	152	43	1562	150	35	16	.15	112	7	1034	110	7
17	.20	371	54	1366	173	48	17	.13	152	10	1244	163	7
18	.14	134	29	946	133	50	18	.14	162	10	1220	153	14
19	.14	116	22	758	98	20	19	.12	198	10	1088	108	11
20	.14	127	27	802	128	48	20	.13	154	6	976	130	11
21	.14	152	32	936	90	28	21	.13	156	9	1080	143	2
22	.14	127	22	1104	110	39	22	.13	190	8	1102	160	5
23	.16	172	21	1236	163	44	23	.14	120	9	1154	105	8
24	.17	118	35	934	88	25	24	.13	176	9	1112	153	12
25	.16	162	43	1130	153	32	25	.13	144	11	1192	163	17
26	.16	157	41	1228	130	37	26	.13	116	7	1260	168	11
27	.16	136	37	1118	115	45	27	.13	168	9	1284	155	12
28	.16	149	33	1062	115	36	28	.14	184	15	1026	138	12
29	.15	267	37	1184	113	44	29	.14	134	10	1050	138	14
30	.16	142	24	1228	120	37	30	.14	142	7	1096	98	11
Average	.16	166	29	1068	138	37	Average	.13	140	8	1143	140	12

APRIL

Date	(1938) Flow (MGD)	Fe (PPM)	$FeSO_4$ (Lbs.)	+Cl (Lbs.)	Ferrisul (Lbs.)	Cost $	Date	(1939) Flow (MGD)	Fe (PPM)	$FeSO_4$ (Lbs.)	+Cl (Lbs.)	$FeCl_3$ (Anhyd.) (Lbs.)	Cost $
1	8.7	3.9	.....	.....	1120	16.58	1	14.66	3.0	2000	180	.....	19.45
2	8.1	4.2	.....	.....	1040	16.58	2	15.47	2.5	1275	160	150	20.18
3	7.8	4.0	.....	.....	1040	15.80	3	15.01	3.3	2000	205	.....	19.65
4	7.6	3.6	472	16	530	11.78	4	14.60	2.4	1400	175	150	21.53
5	8.5	4.3	1212	160	.....	13.61	5	12.97	2.9	1500	185	.....	16.00
6	8.1	4.7	1544	238	.....	17.88	6	16.04	2.2	1400	170	150	21.28
7	8.3	4.8	1628	136	.....	15.60	7	14.21	1.7	1000	150	150	17.88
8	9.5	4.7	1804	218	.....	19.10	8	13.67	2.3	1275	160	150	20.08
9	8.8	3.9	1400	174	.....	14.94	9	10.73	2.3	1000	108	.....	10.40
10	9.5	3.4	1352	176	.....	14.62	10	13.52	2.3	1250	144	150	19.52
11	9.5	4.6	1800	198	.....	18.56	11	13.72	3.2	1750	194	.....	18.05
12	9.4	3.6	1384	120	.....	13.37	12	11.56	3.2	1488	180	.....	15.75
13	9.1	6.0	2108	166	.....	19.87	13	12.65	1.5	750	100	300	21.17
14	9.0	5.0	1836	170	.....	17.98	14	12.54	2.1	1040	130	.....	11.14
15	8.4	5.6	1896	160	.....	18.10	15	11.60	2.7	1240	168	.....	13.70
16	7.1	5.2	1520	124	.....	14.47	16	10.89	2.2	935	132	150	16.85
17	6.9	5.2	1472	138	.....	14.50	17	12.45	3.4	1700	232	.....	18.70
18	9.1	7.4	2632	180	.....	24.04	18	11.88	2.4	1150	170	150	19.83
19	8.9	10.0	3572	356	.....	35.58	19	13.28	2.5	1320	196	.....	15.00
20	8.5	5.8	1972	186	.....	19.46	20	12.92	3.0	1530	206	.....	16.78
21	9.0	4.2	1544	200	.....	16.72	21	12.81	2.1	1063	146	150	18.28
22	8.9	6.0	2112	184	.....	20.46	22	12.07	1.8	895	128	300	23.06
23	8.2	5.7	1912	192	.....	19.18	23	11.64	3.2	1500	188	.....	15.70
24	8.0	5.8	1864	188	.....	18.68	24	12.37	2.4	1200	182	150	19.73
25	8.6	5.6	1936	192	.....	19.34	25	12.41	2.5	1275	178	150	20.68
26	8.5	7.8	2608	154	.....	23.24	26	12.23	4.1	2000	212	.....	20.35
27	8.5	3.7	.....	.....	1020	15.10	27	12.00	3.5	1700	190	.....	17.55
28	8.6	3.2	.....	.....	908	13.40	28	11.79	2.6	1250	170	150	20.23
29	9.2	2.9	.....	.....	855	12.60	29	10.90	3.0	1310	130	150	19.58
30	8.2	4.2	.....	.....	1130	16.70	30	10.54	2.3	1000	134	150	17.44
Average	8.56	4.97	1808	175	965	17.59	Average	12.77	2.6	1340	167	90	*19.83

Chemical cost per m.g. = $2.06

*Includes cost of anhydrous ferric chloride used during month.

Chemical cost per m.g. = $1.60

sonnel or supervision.

The results for the first five months of 1939, reproduced herewith, speak for themselves. With monthly flows as high as 40% over designed capacity of the plant, the overall reduction in suspended solids and B.O.D. averaged 91% for this period.

MAY

Date	(1938) Susp. Solids Air	Raw	Eff.	Mixed Liquor	5-Day B.O.D. Raw	Eff.	Date	(1939) Susp. Solids Air	Raw	Eff.	Mixed Liquor	5-Day B.O.D. Raw	Eff.
1	.16	128	19	1166	65	17	1	.14	188	9	1130	163	16
2	.15	179	32	1126	153	45	2	.14	120	11	1180	138	11
3	.16	132	19	1182	110	30	3	.14	196	12	1216	183	18
4	.16	181	31	978	170	37	4	.14	198	16	1100	185	21
5	.15	160	30	1028	113	44	5	.14	184	10	964	158	19
6	.15	140	29	966	125	43	6	.15	164	14	1120	178	15
7	.17	129	23	902	155	35	7	.15	150	12	1006	170	17
8	.18	128	39	900	90	30	8	.14	218	15	1158	153	17
9	.16	190	37	1018	145	48	9	.14	166	14	950	225	14
10	.16	228	38	1068	78	22	10	.14	162	16	1024	145	19
11	.14	220	29	1188	110	43	11	.15	124	11	1042	168	17
12	.16	172	36	1130	128	35	12	.15	156	16	806	118	22
13	.16	169	32	1180	95	31	13	.14	118	10	1030	105	13
14	.16	147	26	1214	148	34	14	.14	142	11	1034	105	11
15	.15	126	22	1384	73	19	15	.14	223	16	1256	198	13
16	.13	158	23	1818	105	34	16	.15	162	11	1064	115	18
17	.14	179	35	1290	83	31	17	.15	128	8	1056	175	17
18	.14	150	43	1302	110	31	18	.15	166	11	1036	215	17
19	.14	149	33	938	123	42	19	.15	182	12	1054	163	15
20	.14	168	27	1046	45	35	20	.15	164	10	1116	195	17
21	.14	152	23	1218	130	37	21	.15	200	9	1090	188	9
22	.16	174	44	950	110	32	22	.15	184	9	1152	213	20
23	.14	182	35	1146	128	51	23	.15	176	6	1102	158	17
24	.13	156	37	1140	118	37	24	.14	190	15	1026	195	20
25	.15	200	47	1606	145	56	25	.14	172	10	1038	200	21
26	.14	186	35	1314	90	30	26	.13	154	11	1056	175	27
27	.14	126	24	1064	115	25	27	.14	126	10	952	230	23
28	.13	169	39	1032	105	26	28	.14	180	12	1060	250	23
29	.15	102	30	1084	108	36	29	.13	194	18	1064	193	18
30	.16	142	20	1008	155	29	30	.14	116	13	1228	133	21
31	.15	168	36	986	163	49	31	.14	156	16	1088	173	19
Average	0.15	161	31	1141	116	35	Average	0.14	166	12	1071	173	18

MAY

Date	(1938) Flow (MGD)	Fe (PPM)	$FeSO_4$ (Lbs.)	Ferrisul (Lbs.)	+Cl (Lbs.)	Cost $	Date	(1939) Flow (MGD)	Fe (PPM)	$FeSO_4$ (Lbs.)	Ferrisul (Lbs.)	+Cl (Lbs.)	Cost $
1	7.8	4.0	.....	.....	1020	15.10	1	11.02	4.4	1950	200	.....	19.72
2	8.5	3.7	.....	.....	1020	15.10	2	10.88	4.5	2000	290	.....	22.51
3	7.8	4.0	.....	.....	1020	15.10	3	11.27	4.3	2000	250	.....	21.43
4	7.9	4.5	.....	.....	1170	17.30	4	10.53	5.4	2270	230	.....	23.06
5	8.0	3.9	.....	.....	1020	15.10	5	10.50	4.0	1700	210	.....	18.10
6	8.0	3.8	.....	.....	995	14.73	6	9.88	3.7	1500	180	.....	15.88
7	7.6	4.9	.....	.....	1215	17.98	7	9.36	3.9	1500	194	.....	16.25
8	7.0	7.0	.....	.....	1595	23.62	8	10.49	7.0	2960	302	.....	29.90
9	8.2	5.8	.....	.....	1560	23.10	9	10.31	6.0	2500	328	.....	27.28
10	8.1	5.9	.....	.....	1560	23.10	10	10.29	3.3	1400	164	.....	14.68
11	8.4	3.8	.....	.....	1035	15.30	11	9.89	5.0	2025	264	.....	22.00
12	7.8	3.2	.....	.....	825	12.20	12	9.84	3.8	1530	196	.....	16.50
13	7.8	6.1	.....	.....	1560	23.10	13	11.22	3.6	1620	200	.....	17.32
14	9.1	5.4	.....	.....	1600	23.60	14	10.56	4.2	1798	238	.....	19.70
15	8.6	5.6	.....	.....	1545	22.85	15	10.38	4.0	1700	216	.....	18.35
16	9.7	4.5	.....	.....	1440	21.30	16	9.62	4.3	1700	215	.....	18.33
17	9.2	3.4	.....	.....	1020	15.10	17	9.58	4.1	1620	200	.....	17.27
18	8.8	5.2	.....	.....	1520	22.40	18	8.42	4.4	1490	200	.....	16.32
19	8.5	5.5	.....	.....	1520	22.40	19	9.54	3.8	1450	200	.....	16.02
20	8.4	5.6	.....	.....	1520	22.40	20	9.01	3.5	1300	148	.....	13.55
21	8.1	5.8	.....	.....	1520	22.40	21	8.23	3.3	1100	114	.....	11.10
22	7.9	6.0	.....	.....	1545	22.80	22	9.62	4.4	1725	210	.....	18.35
23	7.9	7.6	.....	.....	1955	29.00	23	9.86	11.0	4400	492	.....	45.40
24	8.6	5.4	.....	.....	1520	22.40	24	9.16	4.8	1785	221	.....	19.80
25	8.4	5.5	.....	.....	1480	21.90	25	9.31	11.0	4200	436	.....	42.50
26	8.8	5.3	.....	.....	1520	22.40	26	9.22	5.6	.....	.....	1666	24.65
27	9.5	4.7	.....	.....	1470	21.70	27	8.53	8.0	.....	.....	2080	30.80
28	9.2	5.0	.....	.....	1520	22.40	28	8.32	8.1	.....	.....	2180	32.20
29	8.4	5.8	.....	.....	1545	22.85	29	9.55	7.0	.....	.....	2160	31.90
30	8.0	4.8	.....	.....	1260	18.60	30	8.03	7.4	.....	.....	1925	28.50
31	9.1	6.0	2160	138			31	9.53	6.0	.....	.....	1925	28.50
Average	8.36	5.1	2160	138	1370	$20.28	Average	9.74	5.3	1969	216	1985	$22.52
Chemical cost per m.g. = $2.42							Chemical cost per m.g. = $2.31						

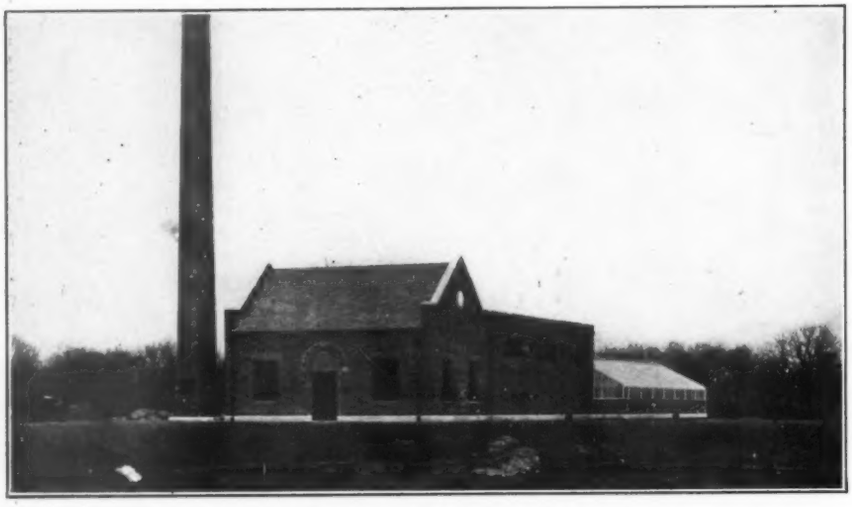
A PARK COMES TO THE SEWAGE PLANT

(A Letter From "Hank" To "Tom")

By HENRY T. HOTCHKISS, JR.
Supervising Chemist
LARCHMONT, N. Y.

An Ejector Station

"YESTERDAY"



Our Sewage Treatment Plant
(The Latest-thing in 1925)

Dear Tom:

I have appreciated very much your "letters" that have appeared in WATER WORKS & SEWERAGE — so here's one for you in return.

When people find their way from the main road to our Water Purification Plant they are astonished to see such a beautiful spot so near home. I suppose you have been reading about the recreational features that have been provided lately at some of the newer water works. Well, to advance public relations and good will we too have cleared some picnic spots down *below* our main reservoir and quite a few groups have come out to enjoy them. Some fishing is also allowed responsible residents. They apply to the Village Clerk who issues a limited number of permits. During the season there's a waiting list of those who want to try their luck on our preserve. Our water plant is a little too far out to think of developing formal gardens, as some places do. Just the same, the Village is going to have a fine park and you'll be surprised to hear where it's being laid out. Yes, sir, right down at the Sewage Disposal Works and dump.

A Dump Passes—

I've marveled at the way that place has changed. The old salt marsh lowlands are being filled and a lot of grading has already been done. What used to be the public-dump is no more. And this park isn't just to look at either. We've a ball diamond, soft ball layout, tennis courts, swings, etc., and our Village Engineer has just put in a wading pool for the kiddies which is about ready for use at this writing. The dump is being abandoned for an incinerator elsewhere.

A nursery for trees has been maintained up by our reservoir for some years past. The larch, evergreens and other varieties have been moved down and planted in accordance with a plan already worked out. A planting of young oaks and other species has been set out as a reserve for the future needs at the park and along the curb area.

"Yesterday and Today"—

I was looking through an old bulletin "Sewage Treatment Plants," published by the Portland Cement Ass'n, and was impressed with some "yesterday" pictures of our sewage plant and one of the underground pumping stations. These were taken at about the time the buildings were completed. Recently, I got out my camera and took a couple of "shots" for comparison. You can see from the enclosed what a difference time and a little thought about planting makes. Guess our "windmill" is the

"TODAY"

The Same Plant—1939
(As it looks from U.S. Highway No. 1.)

Our Magnolia Ave. Sewage Lift Station

The location justified this little gardened enclosure. The home through the trees is hardly visible now.

only one of its kind. The stack, which is now inside the mill, constitutes part of the forced draft system of ventilation, but we won't go into that this time except to say that back in the early twenties that was considered the height of odor control.

I've a notion we've got better tools to work with for odor control now, both for sewage and water. With activated carbon and chlorine on hand at all times an operator doesn't have so much to worry about.

Did I tell you how I introduced the chloramine process for water here? First, the Trustees let me get two dry feed machines. Instead of just a dose of alum by way of a concrete solution tank and constant-level orifice box, I changed over to a measured dry feed for alum and also one for alkalinity and pH control at the clear well. Second, I took an ancient chlorinator and put it to work as a prechlorinator.

One of the old alum solution tanks provided a reserve water supply for the chemical feeders should the wash water tank run low. The other I used to mix batches of ammonium chloride. This solution was fed through the old alum orifice box to a point ahead of the aerator nozzles. A good quick mix was thus obtained ahead of the prechlorination chamber. Later, because of corrosion, caused by the chloride, I switched to ammonium sulphate. I now have chloramines whenever I want them. The settling basins and filters have benefitted and I can safely cut down on postchlorination since the requirements are less. Those odors and tastes aren't going to get by if we can help it.

I'll be waiting to hear from you again "Tom" and, believe me, your letters get passed around. We all appreciate them very much.

"Hank."

P.S.: Oh yes, I forgot to tell you that we now have a *real* dry feeder for carbon, instead of a "gadget."

* Old photographs by courtesy of Nicholas S. Hill Associates, Engineers.

A.W.W.A. 1940 Convention Dates Set April 21-25th

Three Kansas City Hotels Named as Co-Headquarters Hotels

An announcement made from A.W.W.A. Headquarters late last month by Secretary Jordan, concerning the 1940 Convention to be held in Kansas City, Mo., sets the dates as April 21-25th, Sunday-Thursday inclusive. The early dates were selected because of the ideal weather usually experienced in Kansas City late in April.

Three hotels closely located and all within two blocks of the Kansas City Auditorium have been named as co-headquarters hotels. These are the *Phillips, President* and *Muehlebach,* their respective rates being given below.

The following paragraphs have been taken from Secretary Jordan's release of July 25th.

"All exhibits and technical sessions will be held in the Auditorium. This building is located just two blocks distant from the hotels. The exhibit facilities are equal—in many ways superior—to those at Atlantic City. The rooms available for meetings are definitely superior.

J. Herman Smith, of the Hersey Manufacturing Company, South Boston, Mass., will again be Exhibit Chairman.

The spring meeting of the A.S.C.E., which is also to be held in Kansas City, on April 17-19, makes it possible for members of the two associations who travel some distance to make but one trip and attend both meetings.

The three headquarters hotels have set aside 750 rooms for reservations by A.W.W.A. members. Ample housing facilities are available in other hotels for those who desire them. Early reservations guarantee satisfactory accommodations.

The following room rates apply:

Rooms	Phillips	President	Muehlebach
Single	$2.50-5.00	$2.50-5.00	$3.50- 6.00
Double	4.00-8.00	4.00-6.50	5.00- 8.00
Twin Beds	6.00-8.00	5.00-8.00	6.00-10.00

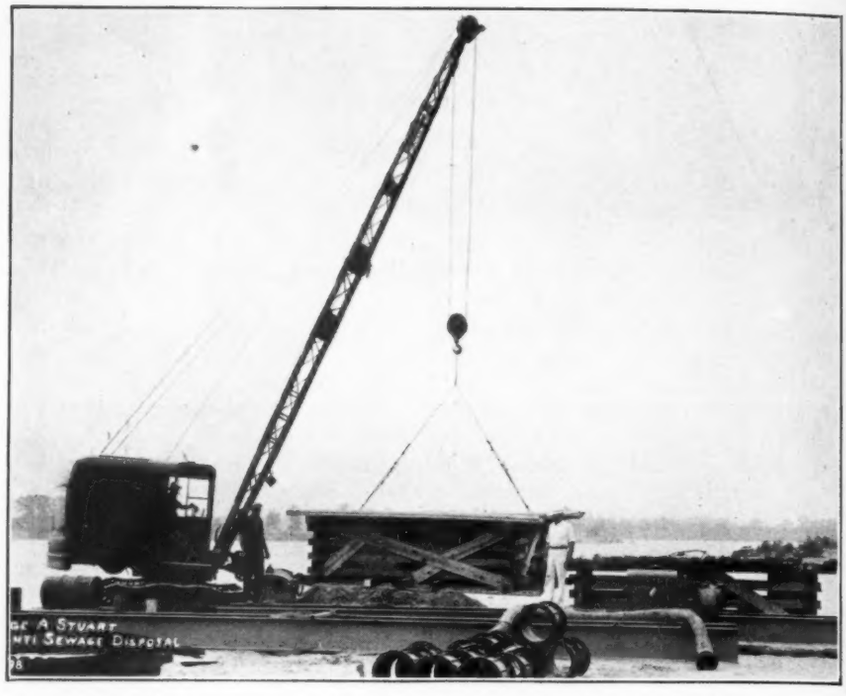
In writing for reservations, be sure to mention your A.W.W.A. membership, since that will insure special handling.

SUBAQUEOUS STEEL OUTFALL SEWER LAKE-BOTTOM LINE FOR YPSILANTI SEWAGE-TREATMENT PLANT LAID BY THREE MEN

By E. P. ECKHARDT*
ANN ARBOR, MICHIGAN

WORKING only thirteen days (312 man-hours), three men were able to excavate for, lay, and backfill 960 feet of 16-inch steel pipe for an outfall sewer in a shallow lake at Ypsilanti, Michigan, in July, 1938. This sewer was constructed as part of a P. W. A. project which included the construction of a Sewage Pumping Station and a Primary Sewage Treatment Plant. Once it was necessary to suspend work for four days due to high water, but aside from that there was no difficulty of any sort throughout the entire construction of the outfall line.

The sewer was constructed of 15½" I.D. seamless tubing with ¼" walls, shipped in 40-foot lengths. Dresser couplings of the long type were used to join the sections together and both pipe and couplings were lined and coated with bituminous enamel.



Crane Preparing to Launch One of the Cribs Used in Construction. Dresser Couplings in Foreground

Three Man Crew Handles the Job

A foreman, a crane operator and one relief laborer were all the help used on the entire construction.

A light weight one-yard shovel, which was used in excavation for the Sewage Treatment Plant, was also used for excavation of the outfall sewer. However, for this work a drag line attachment was used and a half-yard bucket attached thereto. The half-yard bucket was preferred over the one yard bucket so as to reduce the strain on the cribs on which the crane worked. Two cribs or mats were used, each about five feet high and about fifteen feet square. They were constructed of 6x6's bolted together and crossed-braced with two thicknesses of 2" planking nailed to the top. A cable-sling was attached to each to assist in picking them up and moving them ahead. The crane worked about 17 or 18 feet to one side of the line and dragged across it. (see photos and sketch)

The sewer was laid on a uniform grade and the cut varied from six inches to four feet. At every hundred feet, the trench grade was checked by measurement below the surface of the water on the stationing line, the level of the water being determined daily from a bench mark on shore.

As to the lake, the bottom was mostly gravel under six inches of silt. The average depth was five to six feet, the lowest point being seven feet deep. Therefore, the caterpillars of the crane were partially sub-

Pipe String of First Seven Sections Floated Into Position. Relief Laborer Tightening a Coupling

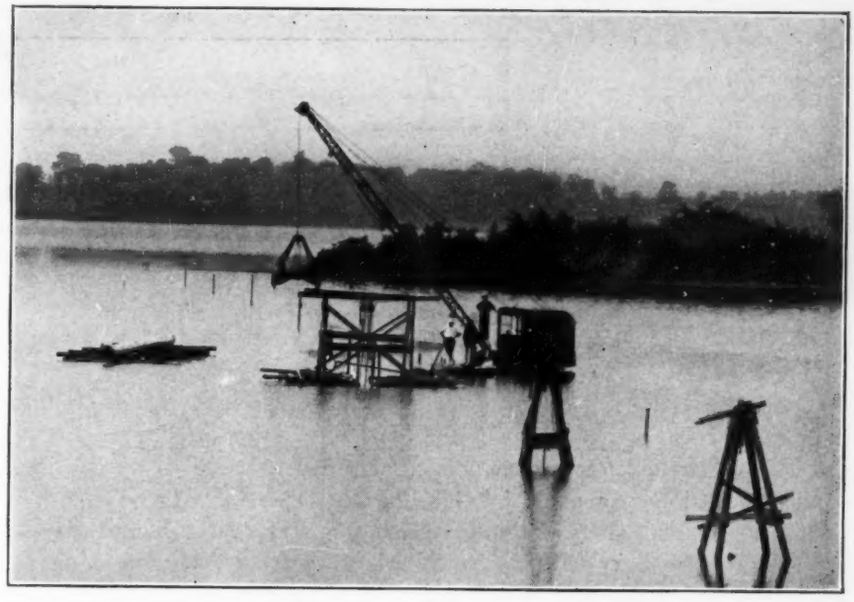
*Shoecraft, Drury and McNamee, Consulting Engineers.

merged most of the time, the water coming up to just under the floor of the crane during the one period of high water.

How the Job Was Done

All of the pipe was stored on the shore on a cribbing high enough so that they could be rolled onto a barge by hand. The first seven lengths were assembled with the assistance of the crane, which was on the shore. A cap was left on each end and the string of pipe was left floating for the five days during which time the crane was excavating for the line. During this time there was no perceptible infiltration into the line. After the crane finished excavating for the first seven lengths, the line was floated into position. The shore-end had to be accurately located, as a manhole was to be built there. The crane picked up the outshore or seventh length and the cap was taken off. Then the crane lowered the pipe until the bottom of it was just under water. The water flowed to the vented shore end which sank immediately. The crane then raised the seventh section and a raft, with a chainfall mounted on a cross-frame at each end, was centered over the pipe and took the load, keeping the end out of the water at all times. (see sketch) No more water was allowed to enter the pipe, so as to keep it more buoyant and not overstress the joints.

The crane then proceeded to excavate for the next length of pipe. When it was completed, the barge, which was fitted with an outboard motor, brought out the next length of pipe. The coupling and one ring was slipped on the last completed section and the other ring slipped on the new section. The crane then tilted the outer end of the new length, and by chainfalls the section of the coupled pipe was lowered, until the two pipes were in a straight line. In this position the two sections of pipe were easily joined, and the coupling bolts tightened by the relief laborer. It will be noted that the entire joint was made above water with almost as much ease as if the pipe were on the ground. The time required to bolt up the couplings averaged about 15 minutes each.



In This Picture is Seen the Pipe Raft (left) and the Chain-fall Raft Straddling and Holding Up the End of the Line. The Crane is Excavating Trench for Next 40-ft. Long Pipe

See sketch.

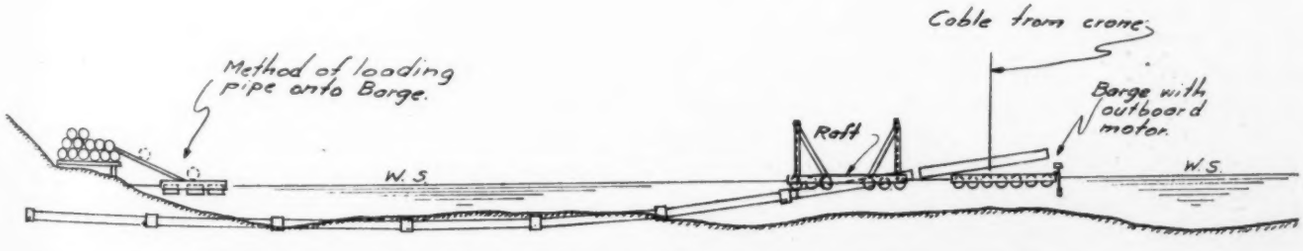
After the joint was completed, with the crane still holding the new section, the chainfalls on the raft were lowered until the crane took the entire load. Next, the crane lowered the pipe until the end was about three feet above water; the raft was then moved ahead, the sling was placed and the chainfalls were tightened, taking the load, and the crane was then free to start excavating for the next length. The remaining lengths of pipe were laid in a similar manner. The last pipe was left with an unsupported length of twenty feet projecting into an old river channel, which was about twelve feet deep. The grade of the pipe was then checked and the trench backfilled by the crane as it moved back to shore. This took a day and a half. A cofferdam was built around the shore-end of the pipe. The resulting hole was then pumped dry, the manhole built and the cap taken off of the pipe.

Since Dresser Couplings made it possible to make tight joints above water prior to lowering, it was not felt necessary to test on completion for leakage. The simplicity of the whole operation made it unnecessary to use a diver at any time.

The Flexible Couplings

The Dresser Couplings, which appear in front of the crib in one of the pictures, consist of a steel sleeve, or center-ring as they are commonly known, two endless rubber-compound gaskets, two end rings known as followers, and nine long bolts. When the bolts are tightened the gaskets are compressed between the pipe surface and the flared ends of the center rings by the follower rings. Only plain end pipes are required with these couplings.

Mr. George Stuart, who installed the sewer, was sub-contractor; Strandberg & Spencer, Inc., of Chicago, Ill., were the general contractors, and Shoecraft, Drury & McNamee of Ann Arbor, Mich., were the consulting engineers.



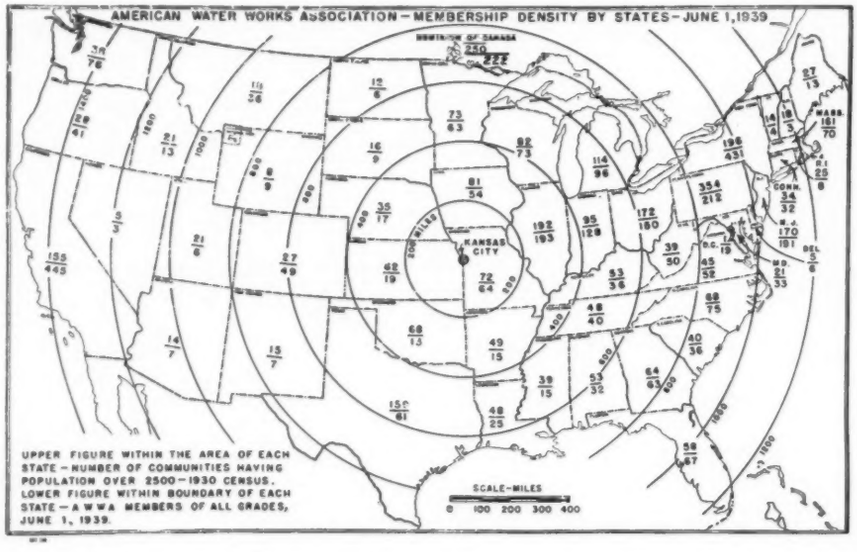
Sketch Depicting Method of Handling and Laying the Ypsilanti Outfall Sewer

The Editor's Comments

"WHY KANSAS CITY?"

THE choice of Kansas City as the 1940 Convention City of A.W.W.A. has been rather loudly and openly questioned by many members, and criticized by not a few—particularly by those who have to their credit a large number of conventions attended. The unpopular selection was made by the Convention Place Committee, the recommendation of which was accepted and unanimously approved by the Board of Directors. Such was done, however, only after hearing the reasons for the choice painstakingly presented and explained, because the recommendation came somewhat as a surprise to many on the Board.

In the July number of the Journal of A.W.W.A. Secretary Jordan has explained in part the reasons behind the selection of Kansas City. In addition, this metropolis of the mid-west enjoys a fine recent history in respect to attendance records of association conventions there held. Furthermore, words from "satisfied customers" concerning the unexcelled Auditorium facilities and comfort, for those who exhibit equipment and materials and for those who go to learn about such, and those who wish to attend technical sessions and committee meetings as comfortably as circumstances permit, constituted evidence which bore much weight. The cluster of first class hotels, located closer to the Auditorium than were those occupied at Atlantic City offering attractive rates, carried a goodly share of influence. And, the performance reputation of the Kansas City Convention Bureau was another "spike" which counted.


AMERICAN WATER WORKS ASSOCIATION – MEMBERSHIP DENSITY BY STATES – JUNE 1, 1939
KANSAS CITY
200 MILES
400 MILES
600 MILES
UPPER FIGURE WITHIN THE AREA OF EACH STATE – NUMBER OF COMMUNITIES HAVING POPULATION OVER 2500 – 1930 CENSUS.
LOWER FIGURE WITHIN BOUNDARY OF EACH STATE – A W W A MEMBERS OF ALL GRADES, JUNE 1, 1939.
SCALE – MILES
0 100 200 300 400

However, from the standpoint of the best interests of A.W.W.A., *explicitly,* the geographic location of Kansas City seemed to be the principle answer to the question—*"Why Kansas City?"*

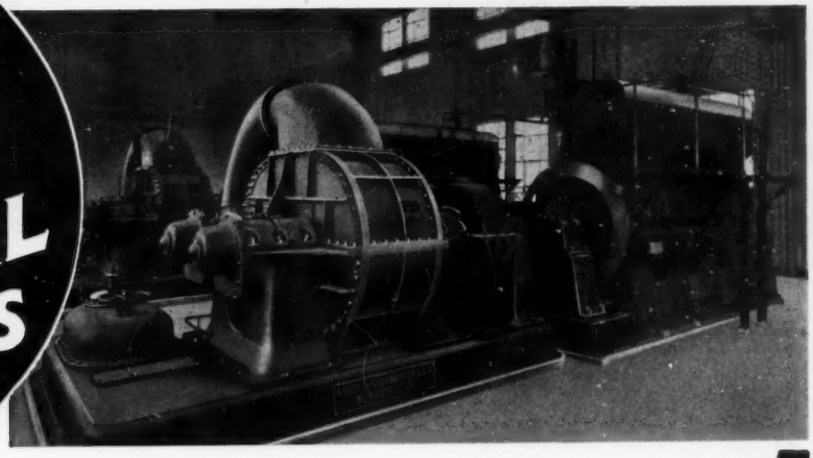
This part of the story is most easily told by a look at the accompanying study map which the Convention Place Committee had before it—a map produced by a long-range visioned Secretary who believes that if Mohamet cannot go to the mountain, the mountain should be taken to Mohamet. In this instance, "Mohamet" being the water works operator and the "mountain" A.W.W.A., it is evident that within easy and inexpensive travel distances of Kansas City there are more Mohamets than the Mountain is content to let go "mountainless." Regarding the numbers, we might call these "fractions" (shown state by state) proper and improper fractions. Those which are "proper" have a denominator greater than the numerator—the upper figure being the number of cities in the state of more than 2500 population and the denominator being the number of A.W.W.A. members within that state. With the exception of Colorado, Indiana and Illinois the picture for the states within the 600 mile zone of the Convention City of 1940 is an exceedingly improper one, as the fractions indicate.

If for the sake of this story we may call water works operators and managers on the outside of A. W.W.A., but benefitting (know it or not) from its good work, "the Heathen," then there is much missionary work needed in that area into which the Association is going in 1940 for the first time in its history—admittedly to bring in new faces and to best serve the greatest numbers, socially as well as technically. Only time will prove the wisdom of those who guide A.W.W.A.—or their mistake—in having chosen Kansas City. We believe that loyal members will agree that there was a major reason, supported by several less major but important reasons to those who must make conventions "click."

L. H. Enslow

Two 10,000 CFM, 7½ lb.-400 RPM gas engine driven blowers recently installed at the Cleveland Southerly Plant, Cleveland, Ohio.

Low cost AIR for SEWAGE DISPOSAL PLANTS

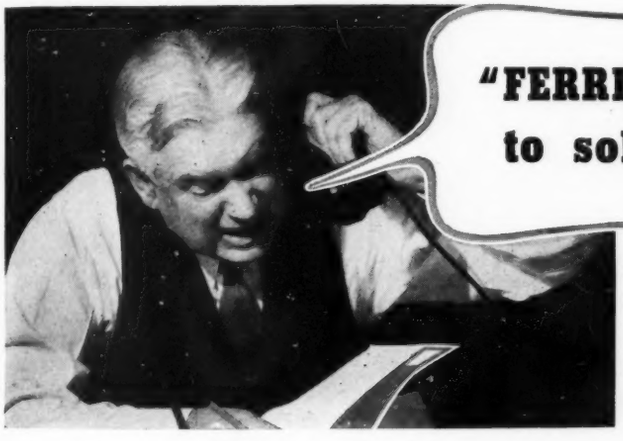


Roots CONNERSVILLE BLOWER CORP.
908 Mount Avenue
CONNERSVILLE INDIANA
NEW YORK • CHICAGO • POTTSTOWN, PA. • SAN FRANCISCO
PITTSBURGH • BOSTON • DETROIT • ST LOUIS • LOS ANGELES

Roots-Connersville positive displacement blowers driven by direct connected gas engines, using power available in sludge gas, offer the most economical method of supplying air for activated sludge plants.

About 25% more power is obtained from gas used in this manner than where electric current is generated and then converted back into power.

TOMORROW'S ENGINEERING APPROVED BY YESTERDAY'S EXPERIENCE



"FERRISUL is the economical way to solve trickling filter trouble"

Ferrisul, added to sewage before retention in the primary tanks, either in precipitating or non-precipitating dosages, has proved most effective in overcoming many trickling filter troubles. In addition, Ferrisul frequently has delivered substantial savings in operating costs.

HOW FERRISUL WORKS

Precipitating Dosages—Through floc formation in primary tanks, Ferrisul corrects grease problems effectively and decreases the suspended solid load on the filter bed. This gives more efficient oxidation of settled sewage flowing through the bed. Ferric floc in the filter acts as a catalyst in the interchange of oxygen.

The ferric compound, through its reduction to ferrous, provides oxygen for organic matter present. In the presence of air, ferrous again becomes ferric and the process continues in this cycle.

Non-Precipitating Dosages—Added to incoming sewage, Ferrisul flocs inside the trickling filter instead of in the primary tanks. Oxidation is hastened through the seeding of the filter with ferric iron. After the bed is well seeded, enough iron passes the filter to bring about re-flocculation in final settling tanks.

The result is an improved effluent, especially in B. O. D. removal. Scum is held to a minimum in final settling tanks, and fly, worm and odor nuisances are reduced.

If you have trickling filter difficulties—or any coagulation problem—get the facts about Ferrisul. Your request will bring full details.

MONSANTO CHEMICAL COMPANY, Merrimac Division, Everett Station, Boston, Massachusetts.

MONSANTO CHEMICALS
SERVING INDUSTRY...WHICH SERVES MANKIND

FERRISUL FOR WASTE AND SEWAGE DISPOSAL

STORE IT IN THE OPEN

Until you're Ready to Use it

No roof or tarpaulin is needed to guard Tegul-MINERALEAD against storm or flood ● The ingot ISN'T HURT BY WATER ● These 10 lb. blocks are EASILY HANDLED and shipped ● COMPOSITION CAN'T CHANGE under jolting in transit ● Tegul-MINERALEAD makes PERMANENTLY TIGHT, trouble-free joints, amply able to withstand any vibration ● JOINTS HEAL ALMOST AT ONCE. Trenches can be back filled and traffic hazards cleared up ● Send for more information. The ATLAS MINERAL PRODUCTS Company of Pa., Mertztown, Pennsylvania.

Tegul- MINERALEAD

MULTI-ZONE FURNACES

CONSTRUCT - DESIGN - SUPERVISE - 155 EAST 44TH ST. - NEW YORK - UNDERPINNING AND FOUNDATION CO.

For Incineration of SEWAGE SLUDGE, SCREENINGS, GROUND GARBAGE

Operation is without auxiliary fuel—odorless!

- SEPARATE DRYING AND INCINERATING ZONE.
- FLEXIBLE AND AUTOMATIC TEMPERATURE CONTROL.
- ALL GASES COMPLETELY DEODORIZED.
- RESIDUE UNIFORM, INERT, NON-OFFENSIVE ASH.
- OPERATING RESULTS POSITIVE AND LOW IN COST.

INSTALLATIONS AT
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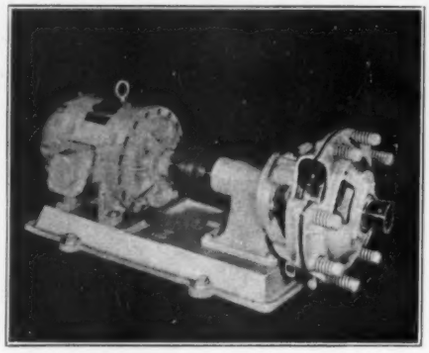
MULTI-ZONE FURNACES

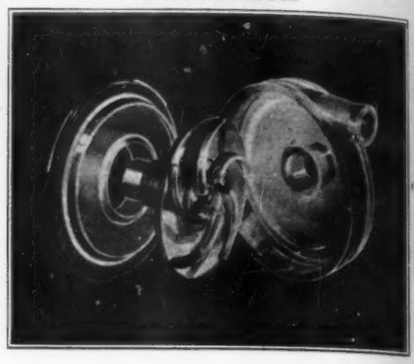
Embody Greatly Improved Principles of Multiple Hearth Operation

UNDERPINNING & FOUNDATION CO., Inc.
155 East 44th St.
NEW YORK, N. Y.

EQUIPMENT NEWS

At Last—a Successful Glass Pump (A Nash-Corning Production





● An entirely new kind of a pump—the Nash Glass Centrifugal—has been announced by the Nash Engineering Company.

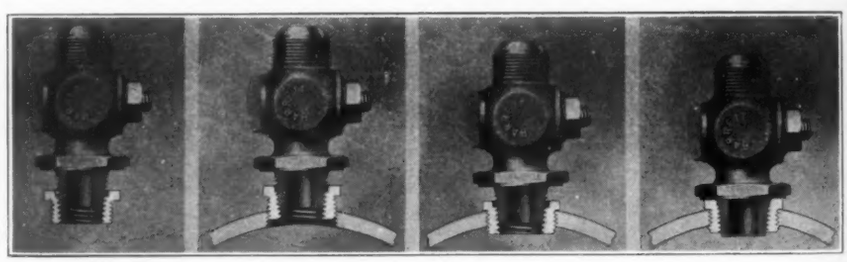
The new pump has the mechanical advantages of metal, with the smoothness and resistance to wear and chemical attack possessed by glass. The above cuts show the all-glass impeller and casing and the completely assembled unit, with its metal protective casing and splash and fume proof motor.

Bidding fair to be the answer to the chemical and sanitary engineer's prayer, it is a long needed "tool" in the handling of acids, ferric chloride and the like—hot or cold. The pump proper is constructed of "PYREX" heat and shock resisting glass which is not affected by temperatures up to 150°F. in standard design or 200°F. in special design.

Through port holes in the protective casing, the glass pump may be seen through and solution being pumped and pump operation inspected at will. The unit may be laid open and reassembled in simple and quick fashion. In reassembly the proper adjustment is said to be practically automatic, due to spring tension on the bolts. Likewise, pressure is automatically relieved if such mounts, for any reason, to a point where the glass casing proper might be in danger of fracture.

Conceived by the Corning Glass Works, designed and manufactured by NASH, this production, combining the skill and experience of two such specialists, is especially worthy of note. For a bulletin thoroughly describing this pump, write The Nash Engineering Co., South Norwalk, Conn.

Corporation Cock with Mushrooming Alloy Bushing



● In an issue some months ago appeared an announcement of a new "Adaptor Bushing," of novel qualities, and especially designed for inserting corporation cocks in thin walled pipes, such as steel pipes.

Its full characteristics were not as clearly understood from the manufacturer's announcement as might have been, so we are "repeating" with a further description of this interesting soft lead-alloy noncorrodible bushing. In fact it appears to have advantages in connection with thick walled pipes also.

The little bushing turns up by hand only a short way on the tapered thread of the corporation cock. (See cut.) On the inside are tapered threads, on the outside the threads are straight. In inserting the cock into the threaded hole in the main the bushing enters first and runs down to the stopping shoulder or bead. Then the cock is turned in to the desired depth. In that operation the alloy is compacted into the tap-hole threads by the wedge action of the tapered cock, which causes the lower end of the bushing also to flare or mushroom out on the inside of the pipe. (In tests they have held against pressures up to 2600 lbs.)

In addition to the clinching effect, the alloy is said to be so passive as to preclude corrosion created by galvanic action frequently experienced between two dissimilar metals such as copper and zinc or brass and iron. It makes a more flexible connection in addition.

This little clincher-bushing, known as the Barrett "Adaptor-Bushing" is made by The Cleveland Brass Mfg. Company, Cleveland, Ohio.

Handy Chlorine Pack

● Proportioneers, Inc., of Providence, R. I., are offering a new handy sized package of Calcium Hypochlorite for use by operators of small plants, sanitarians, health officers, etc.

Showing no favorites, Proportioneers places in the pack two bottles, one containing 6 ounces of Mathieson's "H.T.H." and the other 6 ounces of Penna. Salt's "Perchloron".

The idea behind the "Pro-Chlor" Handy Pack is the hypochlorite will be used before possible loss of strength, thus it may become overall more economical than hypochlorite purchase in larger containers. The 6 ounce idea is that one bottle in 30 gals. of water makes a 1/10th% chlorine solution. Further, with each Chloro-Feeder goes a "Pro-Chlor" pack, so that the operator may determine which of the two high test hypochlorites is most to his liking.

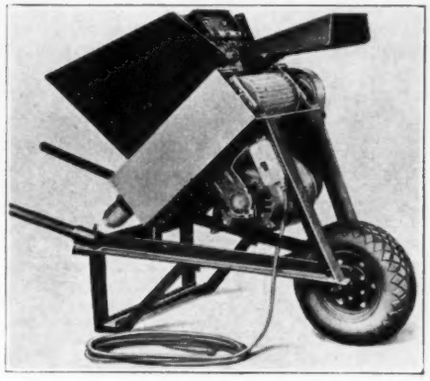
This little pack should prove highly useful in emergencies and in the back end of the cars of sanitarians, public health engineers, health officers and others.

It strikes us, however, that a pill vial, in addition, might have been filled with capsules containing dosages of hypochlorite for treating say 40 gals. of water with 1 part available chlorine, or a barrel with 0.75 parts.

The "Royer Jr." Shredder—Mixer—Loader

● The well known Royer Shredder, for preparing sludge cake for effective spreading as a soil improver or fortifying with chemicals to produce a low cost fertilizing compost, is now available in a smaller size. The "Royer Jr." has just been announced by the Royer Foundry and Machine Co.

Lighter in weight and lower in cost, the smaller model retains all the features of larger machines and has been designed with a sludge shredding capacity representing all that one man can shovel into the hopper. The shredded sludge cake or compost is subject to discharge into trucks direct, into bins or on piles, by adjusting discharge deflector hood shown above multi-spiked high-speed shredding belt around the pulley.



Mounted on a single pneumatic tire the 270 pound machine is readily wheeled by one man. It has a capacity of 3 to 4 cu. yds. of shredded compost or sludge cake per hour, and is reasonably priced.

For details write Royer Foundry & Machine Co., 158 Pringle St., Kingston, Pa.

New Welding Blowpipe For Heavy Duty

● The Linde Air Products Co. offers an improved "Oxyweld" Heavy-Duty Welding Blowpipe for welding and heating ranges above those which the ordinary blowpipe will handle.

Its applications cover a wide range, including tank fabrication, bending large and small steel pipes, forging, straightening and numerous other "smithing" operations requiring intense localized heat over a sufficient area. The blowpipe can be utilized for lighter work.

For literature on Oxyweld Heavy Duty Blowpipes (Type W-26) address—The Linde Air Products Co., 205 East 42nd St., New York City.

"Ferri-Floc" a New Ferric Coagulant

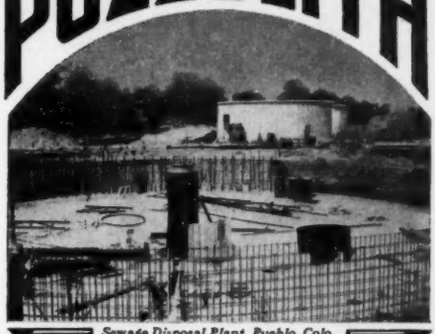
● Tennessee Corporation of Atlanta, Ga., and Lockland, Ohio, announce an improved ferric iron coagulant for which the trade name "FERRI-FLOC" has been chosen.

The material is a ferric sulphate, especially adaptable for use in water and sewage treatment, sludge conditioning and trade waste purification. While we have at this writing no exact information as to the percentage of iron which "Ferri-Floc" contains, the feature which is stressed is its stability in storage and its complete solubility in *cold water*. These two properties make it feasible to feed "Ferri-Floc" in the ordinary dry feeding machines, nowise different from the feeding of filter alum. There is no necessity for control of ratio of chemical to solution water in order to maintain temperature and efficient dissolving reactions and complete availability of its iron content.

Further claims are that it will neither take up or lose water in storage, or when exposed to wet or dry atmospheres. The iron being oxidized, there is no necessity of exact chlorine control to insure absence of residual iron in the treated water, etc.

The folder offers liberal samples for trial or comparison with other coagulants. For description of "Ferri-Floc", or information, write The Tennessee Corporation, Atlanta, Ga.

POZZOLITH



Sewage Disposal Plant, Pueblo, Colo.
Engineers—Black & Veatch, Kansas City, Mo.
Contractors—Thos. Bates & Son, Denver, Colo.
Schwartz Construction Co., Colorado Springs, Colo.

LEAN MIXES EASILY PLACED WITH POZZOLITH

● A report from the Pueblo Sewage Disposal Plant project states, "Approximately 7½% more fine and coarse aggregate was used than on previous work with the same materials, and with practically no difference in 28-day age strengths . . . a slump of 2 inches was obtained with the use of Pozzolith as compared with a slump of ¾" for the same mix without Pozzolith."

Lean mixes, used to control shrinkage and heat, are made easily placeable with Pozzolith with no honeycombing or water gain . . . benefits which are advantageous for YOUR projects. Send for full information today.

PROOF OF EXTRA DURABILITY

Pozzolith concrete is durable concrete! 200 cycles of freezing and thawing prove the greater durability imparted to concrete by Pozzolith. Pozzolith concrete lost only 2% in weight . . . plain concrete lost 22.9%!

Send for full information to

THE MASTER BUILDERS COMPANY
Cleveland, Ohio

In Canada: THE MASTER BUILDERS Co., Ltd.
Toronto, Ontario

MASTER BUILDERS

FERRIC
ISCO
CHLORIDE

Simple to Use • Low in Cost

IN SLUDGE CONDITIONING — Better Performance at reduced cost, including that of dewatering equipment. Boosts filtration rate.

In COAGULATING SEWAGE — Flexibility to handle plant overloads. Greater removal of suspended solids. Improved effluent.

In WATER FILTRATION — A practical and economical coagulant, giving quick forming, fast setting floc.

INNIS, SPEIDEN & CO.
117 LIBERTY STREET, NEW YORK, N. Y.
Chicago Cleveland Boston
Philadelphia Gloversville, N. Y.

FREE

A six day trial of an OK Sewer Cleaning Machine

Consider: We would be out of business long ago if the OK Sewer Cleaner did not sell itself under this offer for we have been merchandising one equipment under this plan for many years.

Under this plan you BUY—no high pressure salesmen at your elbow to force decision—the machine must meet the rigid requirements of your needs. And *you make the decision.*

You have nothing to loose—a favorable decision to accept the trial offer may save money, time and will assure service satisfaction.

Write today.

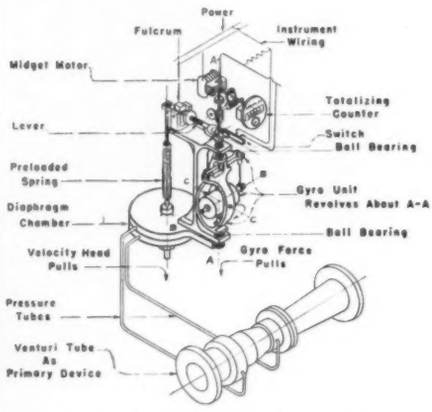
CHAMPION CORPORATION
4714 SHEFFIELD AVENUE
HAMMOND, IND.

The "Gyrometer" by Simplex

● Simplex Valve and Meter Co. announces something distinctly new in meterization. It is the "GYRO-METER".

The Totalizing "Gyrometer" puts to use force developed from a Gyroscopic couple. The force generated varies as the square of the speed of revolution of the Gyro unit (shown beneath the totalizing unit in sketch), when being driven by a shaded pole motor.

The velocity head of the Venturi tube, orifice or Pitot tube, when transmitted to the diaphragm of the totalizing instrument, exerts upon a simple lever a pull proportional to such head. The resulting movement is in turn balanced perfectly by the Gyro-couple force acting on the other end of the lever.



Since the liquid flow, varies as the square root of the diaphragm head, and the motor speed varies as the square root of the Gyro-pull, the angular velocity of the motor shaft will be proportional to the velocity of fluid flow when the two forces are in balance about the lever fulcrum. Thereby, the product of angular velocity and time, (revealed by a counter geared to the Gyro motor shaft), also becomes proportional to the total flow of liquid through the metering unit during the same period of time.

A unique property of the "Gyrometer" is its ability to compensate for usual departures from the flow law at low discharge rates. Thereby, totalization continues with accuracy over a wide range of flow. In contrast to other meter instruments, the diaphragm moves but a few thousandths of an inch in order to actuate the motor switch. Thereby, the transfer of liquid through the pressure lines between meter and instrument becomes of insignificant amount, even for complete changes in flow rate from zero to maximum and back to zero. This last attribute extends the length limitations of connecting piping between water and instrument; also reduces the diameter necessary. Accumulation of sediment in the instrument chamber is thus precluded. The "Gyrometer" may also be actuated by the Simplex Air Differential System when measuring liquids not suitable for pipes or meter chambers.

To obtain a more exact description of the unique "Gryometer", listing other advantageous features, a copy of Bulletin 120 will be sent for the asking by Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Super-Service Fittings by Dresser

● Dresser Company announce a new line of SUPER-SERVICE Fittings. What the features of improvement are over previously available union end friction-type Dresser fittings, in small diameters, is not readily discernable, unless the "Super" fittings have been made more serviceable by meeting the following claims appearing in the recent news-release from the manufacturer. These include: Extra heavy body construction; reserve sealing power for quickly making *tight* joints on undersized, corroded or out of round pipes; "stab" fit, which makes disassembly unnecessary prior to installation; availability in regular and long bodies.

Dresser fittings of the union-end type, although originally designed for quick, bottle-tight and economical work in repairing or renewing service lines, installing meters, temporary lines of new or salvaged pipe, etc.—they have likewise been used effectively in new construction, particularly where dismantling for cleaning or inspection may be desirable; and where vibration or deflection from settling, etc., is a factor.

For a catalog listing the full line of Regular and Long "Super-Service" couplings, ells and tees, write Dresser Mfg. Co., Bradford, Pa.

POSITION WANTED

Sanitary Chemist—Desires position in a sewage or waterworks plant. Record—Chief Chemist of Chemical Treatment Sewage Plant, 2 years; Chemist and Bacteriologist for Illinois State Water Survey, 2 years; U. of Illinois graduate—B.S. in Chemistry; graduate in sewage—2 yrs. Age—28; married; available at once; go anywhere; reasonable salary.—Address "S.C.," c/o Water Works & Sewerage, 155 East 44th St., New York.

Superintendent or Chemist: Water or Sewage. Experience 10 years Chemist in Charge of large water treatment plant, 1½ years Engineer of small group of private water companies. Age 38, married, excellent references. Address "E.L.B." care Water Works & Sewerage, 155 East 44th St., New York City.

WITH THE MANUFACTURERS

Dr. C. R. Payne Becomes Atlas Vice-President

Other Technical and Sales Staff Additions

● Atlas Mineral Products Co. of Mertztown, Pa., announces that Dr. C. R. Payne, for the last four years Director of Research for the company, has been elected a Director and Vice-President of the company. Dr. Payne for 7 years before taking charge of research for Atlas was associated with Mellon Institute of Industrial Research. He was responsible for the development of "Tegul-Mineralead" and other "Tegul" jointing and bonding compounds featured by Atlas.

Also it is announced that Dr. Raymond B. Seymour, for some time connected with Goodyear Tire and Rubber Co., comes to the Research Department of Atlas. Dr. Seymour will devote his efforts to the development of corrosion proof structural materials.

In the Chicago area A. M. Younger has recently been placed in charge of sales for "The House of Jointing Materials", with headquarters at 7827 South Shore Drive, Chicago.

"Infilco" Moves General Offices

● The administrative and sales offices of International Filter Co. have been moved from Chicago's loop district to the company's factory in Chicago. This move was made, according to President P. N. Engel to more effectively coordinate work of the administrative, sales, engineering and production departments.

All manufacturing operations now are confined to the first floor of the main plant building, and to a new structure erected during the past year. The engineering, service, development, and production departments are located on the second floor. The third floor has been completely remodeled to accommodate sales and advertising offices, the laboratories, and the executive offices.

The new office address becomes, thereby, the same as that of the plant—325 West 25th Place, Chicago.

Stanley Jenks Joins Welsbach

● Stanley Jenks, formerly editor of "GAS," and utility sales executive, has joined the staff of the Welsbach Company of Philadelphia.

Welsbach owns and operates Ozone Processes, Inc., manufacturers of equipment generating ozone electrically for water sewage and industrial waste treatment under the Daly patents. Also included in the Welsbach group is Kitson Company, manufacturers of gas stops for high and low pressures, meter connections, shut-off and temperature and pressure relief valves.

W. D. Sizer Becomes Worthington's Executive Engineer

● William D. Sizer ("Bill" to his many friends) has recently been stepped up from the position of Engineer in Charge of Worthington's Centrifugal Engineering Division to that of Executive Engineer in charge of all engineering at the Harrison works of the company. A graduate of Virginia Polytechnic Institute, he has been connected with Worthington since 1920.

In the same announcement from H. C. Ramsey, Vice President of Worthington, notice has come of the promotion of B. R. McBath to Engineer in Charge of the Centrifugal Division.

Northrop & Co. to Represent H. W. Clark Co.

● H. W. Clark Co., Mattoon, Ill., announces the appointment of Northrop & Company, Inc., 50 Church Street, New York, as exclusive sales representatives in the eastern states. Northrop & Co. will handle inquiries and distribute literature covering the Clark line of Meter Boxes, Valve Casings, Meter Testers, Meter Yokes, Service and Valve Boxes, Municipal and Special Castings.

D. J. Erikson Appointed Vice President in Charge of Sales For Hagan Corporation

D. J. Erickson

● D. J. Erikson was recently appointed Vice President in Charge of Sales for Hagan Corporation and its subsidiary companies, Hall Laboratories, Inc., The Buromin Company and Calgon, Inc.

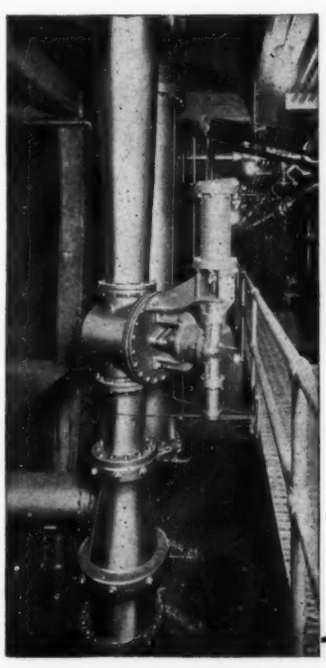
The appointment came as a promotion to Mr. Erikson, who for a number of years has been serving in other capacities with Hagan—Assistant to the President, Sales Manager of Calgon, Inc., and Hagan Automatic Combustion Control.

He will have charge of sales of the Hall Laboratories System of boiler water conditioning; Buromin, for boiler water conditioning; Calgonite, for hotels, restaurants, clubs, hospitals, etc.; Calgon for its various applications in the laundry, dairy, food, textile, leather, paper industries and the water supply field for prevention of scaling up of pipes with lime salts and corrosion suppression—the last being the most recent attainment in hexameta-phosphate treatment.

Which Primary Element?

VENTURI TUBE, FLUME, WEIR,

ORIFICE, OR NOZZLE



The primary element for your metering application should be selected not arbitrarily but by the requirements to be fulfilled and by the economic considerations entering into the installation.

Sewage and sludge are often, though not always, measured by Venturi Tubes, Flumes, or Weirs.

Water may be satisfactorily measured by any type of primary element. Factors such as the cost of pumping, the pressure and the size of pipe or channel usually dictate the device used.

Steam is usually measured by the Bailey Orifice or Flow Nozzle.

Bailey Meter Company holds no brief for any particular primary element, its only interest is in making sure that the user secures the highest accuracy and reliability at the lowest expense.

Detailed information on the advantages of various types of primary elements furnished on request.

MU-18

BAILEY METER COMPANY

1072 IVANHOE RD., CLEVELAND, O.

Bailey Meter Company Limited, Montreal, Canada

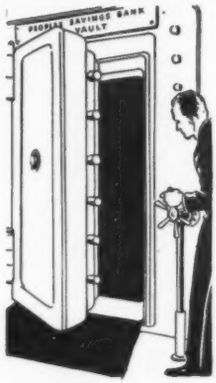
THE BEST *Valve* PROVIDES *Positive Closure*

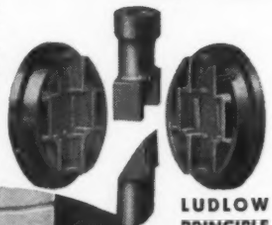
A valve must provide positive closure, even after years of service in the open position. The best valve guarantees this effect with wide, self-releasing 30° angle wedges, and *flexible-action* gates which automatically adjust themselves to seats.

The best valve also assures smooth, positive operation by unwedging and freeing gates *before* raising, wedging them only when they are directly opposite ports. It cleans itself and has no internal guides to cause foul-up; it allows ready replacement of parts through ample tolerances.

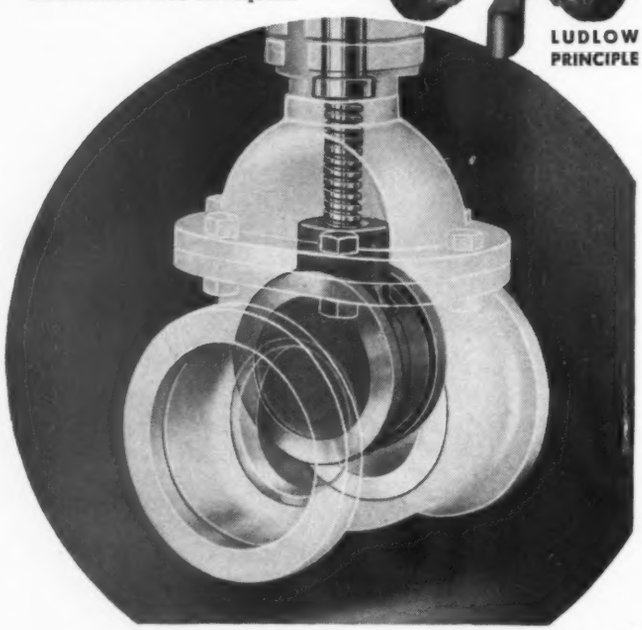
Only the parallel seat, double wedge type slide gate valve provides *all* these essential benefits. This principle, developed and perfected by Ludlow, has been the universally accepted construction in all *water works valves* for nearly three-quarters of a century.

Information free on request.





LUDLOW PRINCIPLE



The LUDLOW VALVE MFG·CO· SINCE 1866 TROY·N·Y·

MEETINGS SCHEDULED

Aug. 24-25—DULUTH, MINN. (Hotel Duluth)
Minnesota Section A.W.W.A. Sec'y-Treas., R. M. Finch, W. & T. Co., 416 Flour Exchange, Minneapolis, Minn.

Sept. 7-8—UNIVERSITY OF VIRGINIA (Monroe Hall)
Virginia Section A.W.W.A. Sec'y., H. W. Snidow, State Dept. of Health, Richmond, Va.

Sept. 12-15—MONTREAL, QUEBEC (Hotel Windsor)
New England Water Wk's. Ass'n. (Annual Convention). Sec'y, Frank J. Gifford, 613 Statler Bldg., Boston.

Sept. 14-15—RAPID CITY, S. D. (Hotel Alex Johnson)
South Dakota Water and Sewage Works Conference. Sec'y. W. W. Towne, State Board of Health, Pierre, So. Dak.

Sept. 15—WILDWOOD, N. J.
South Jersey Assn. Water Superintendents (4:00 P.M.). Sec'y., Walter Spencer, 2707 Bethel Ave., Merchantville, N. J.

Sept. 16—LAKE WEOWN, N. J. (The Grove)
New Jersey Sewage Works Association (1st Annual Clambake). Sec'y. John R. Downes, Bound Brook, N. J.

Sept. 18-19—DENVER, COLO. (Shirley-Savoy Hotel)
Rocky Mountain Section A.W.W.A., Sec'y., B. V. Howe, State Office Bldg., Denver, Colo.

Sept. 18-20—JOHNSTOWN, PA. (Hotel Fort Stanwix)
Western Pennsylvania Section A.W.W.A., Sec'y., E. P. Johnson, 418 Flannery Bldg., Pittsburgh, Pa.
Meeting Jointly with
Western Section Pennsylvania Water Works Operators Ass'n. Sec'y I. M. Glace, 22 So. 22nd St., Harrisburg, Pa.

Sept. 20-22—LANSING, MICH. (Olds Hotel)
Michigan Section A.W.W.A. Sec'y. M. N. Gerardy, Water Board Bldg., Detroit, Mich.
Meeting Jointly with
Michigan Conference Water Purification. Sec'y-Treas., R. J. Faust., Michigan Dept. Health, Saginaw, Mich.

*Sept. 22-23—DICKINSON, N. D.
North Dakota Water & Sewage Conference. Sec'y-Treas., L. K. Clark, Bismarck, N. D.

Sept. 29-30—WINCHENDON, MASS. (Toy Town Tavern)
New England Sewage Works Association. Sec'y-Treas., LeRoy W. VanKleeck, State Dept. of Health, Hartford, Conn.

Oct. 3-4—TOLEDO, O. (Commodore Perry)
Ohio Conference on Water Purification. Sec'y. Thos. R. Lathrop, State Dept. of Health, Columbus, O.

Oct. 5-6—READING, PA. (Berkshire Hotel)
Four States Section A.W.W.A. Sec'y-Treas., Carl A. Heckmer, Washington Sub. San. District, Hyattsville, Md.

Oct. 5-6—TOLEDO, OHIO (Commodore Perry Hotel)
Ohio Conference on Sewage Treatment. Sec'y-Treas., B. M. McDill, Dept. of Health, Columbus, Ohio.

Oct. 6-7—OLEAN, N. Y.
New York State Sewage Works Association. Sec'y-Treas., A. S. Bedell, State Dept. Health, Albany, N. Y.

Oct. 9-11—PITTSBURGH, PA. (Hotel Wm. Penn)
American Public Works Association, Exec. Director, Frank W. Herring, 1313 East 60th St., Chicago, Ill.

Oct. 11-13—KANSAS CITY, MO. (Hotel President)
Missouri Valley A.W.W.A. Sec'y., Earl L. Waterman, University of Iowa, Iowa City, Ia.

Oct. 12-13—CHICAGO, ILL. (Congress Hotel)
Central States Sewage Works Ass'n. Sec'y., W. H. Wisely, State Sanitary Board, Springfield, Ill.

*Oct. 12-14—MORGANTOWN, W. VA. (Morgan Hotel)
West Virginia Section A.W.W.A. & West Virginia Conference on Water Purification (Joint Meeting). Sec'y.-Treas., J. B. Harrington, State Dept. Health, Charleston, W. Va.

Oct. 16-19—DALLAS, TEXAS (Adolphus Hotel)
Southwest Section A.W.W.A. Sec'y-Treas., Lewis A. Quigley, 3320 West Berry St., Fort Worth, Texas.

*(NOTE: Change in dates from previous listing.)

Oct. 17-20—PITTSBURGH, PA. (Hotel William Penn)
American Public Health Association. (68th Annual Meeting.) Exec.-Sec'y., Dr. Reginald M. Atwater, 50 West 50th St., New York City.

Oct. 18-20—ATLANTIC CITY, N. J. (Hotel Haddon Hall)
Pennsylvania Water Works Association. (Annual Meeting.) Sec'y., F. Herbert Snow, 507 Telegraph Bldg., Harrisburg, Pa.

Oct. 19-20—HAMILTON, ONT. (Royal Connaught Hotel)
Canadian Institute on Sewage & Sanitation. Sec'y-Treas., A. E. Berry, Ontario Dept. of Health, Parliament Bldgs., Toronto, Ont.

Oct. 20-21—ATLANTIC CITY, N. J. (Claridge Hotel)
New Jersey Section A.W.W.A. Sec'y., H. N. Lendall, Rutgers University, New Brunswick, N. J.

Oct. 25-28—SAN FRANCISCO, CALIF. (Fairmont Hotel)
California Section A.W.W.A. Sec'y-Treas., Burton S. Grant, Civil Engr., Bureau of Water, Los Angeles, Calif.

Oct. 30-Nov. 1—OSHKOSH, WISC. (Hotel Raulf)
Wisconsin Section, A.W.W.A. Sec'y-Treas., Leon A. Smith, Supt., Water Dept., City Hall, Madison, Wisc.

Nov. 2-3—UTICA, N. Y. (Utica Hotel)
New York Section A.W.W.A. Sec'y., R. K. Blanchard, 50 West 50th St., New York City.

Nov. 6-8—CHARLOTTE, N. C.
North Carolina Section A.W.W.A., Sec'y., R. S. Phillips, 206 Dacian Ave., Durham, N. C.

March 20-22 (1940)—TRENTON, N. J. (Hotel Stacey Trent)
New Jersey Sewage Works Association (Silver Anniversary). Sec'y-Treas., Paul Molitor, Jr., P.O. Box 374, Morristown, N. J.

CATALOGS AND LITERATURE

"Instrumentation of Modern Water and Sewage Plants" is the subject of two new bulletins from Foxboro.

Bul. No. 232, devoted to "Modern Sewage Disposal," presents a basic flow diagram, which uniquely remains in front of the reader across the top while the pages turned contain illustrated description of the transmitting, indicating and recording instruments involved at the points indicated on the flow diagram. Such are for flow (air and liquid), liquid level, temperature, loss of head, pressures, vacuum, etc. Also a pH indicating and recording instrument is included in the very complete line. Centralized Control is featured, with air or electrical transmission involved.

Bul. No. 233, devoted to Filtration and Water Treatment Plants, also features Centralized Control through indicator boards. It pictures typical styles and suggested arrangement of panels and operating tables. Again a typical flow diagram for a filter plant indicates 15 points of application of "Foxboro" instruments, transmitting to indicating (receiving) elements on the central control board.

Both are splendidly thought out and execellently produced bulletins which all designing and operating engineers should find interesting and helpful. For copies write The Foxboro Co., Foxboro, Mass.

"A Rose by Any Other Name," constitutes the theme and the reason for the unusual cover design of Clark Controller Co.'s house organ "The Contactor" for the month of roses. After recounting many interesting facts about these blossoms of romance, and little known historical episodes for which the rose was responsible, we turn a page to the "Song of the Skillet" in the setting of a fisherman's paradise. Then, we find

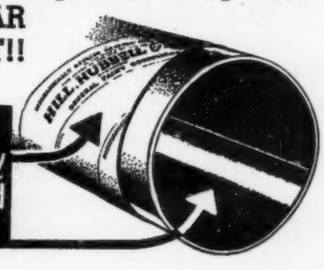
(Continued)

Since 1935 SEVERAL HUNDRED Cities and Towns have installed STEEL PIPE Coated-and-Wrapped and Lined by the HILL-HUBBELL Process

1,718,734 ft. have been used

7 Jobs in 1935
41 Jobs in 1936
80 Jobs in 1937
165 Jobs in 1938
85 Jobs (FIRST 5 months) 1939

STEEL PIPE has made tremendous strides in the past few years and to those who do not appreciate this, the record shown above will be a revelation. STEEL PIPE, when Coated-and-Wrapped and Lined by the HILL-HUBBELL Process, has many advantages that were unknown a short time ago. Before placing your next job why not find out what our product has to offer? We never could have gained such wide-spread acceptance unless we had a FAR SUPERIOR PRODUCT!!



Get Our Story

The Book of PIPE PROTECTION describes in detail how STEEL PIPE is MECHANICALLY Lined and Coated - and - Wrapped at the Mills under ideal conditions. Use your letterhead and write for a copy.

GENERAL PAINT CORPORATION
HILL, HUBBELL & CO. • Division • Cleveland, Ohio
• EXPORT OFFICE SAN FRANCISCO, CALIFORNIA, U. S. A. •

Accuracy

The primary requirement of any metering device is its ability to accurately record and totalize flow rates over a wide range and with prompt response to any change in rate.

Only when all characteristics of both primary and secondary devices are known and properly related can this be done.

Purchasers of Simplex Venturi Tubes and Meters receive, in addition to mere equipment, the results of over 35 years continued studies and research on both the primary device and the meter register. With this knowledge incorporated in the equipment design, accuracies of any Simplex installation satisfy the most demanding requirements of designing and operating engineers.

Let Simplex Engineers show you WHY and HOW you can benefit.

SIMPLEX
VALVE & METER
COMPANY

6743 UPLAND STREET • PHILADELPHIA, PA.

something more pertaining to the culinary art and a list of everyday "Futilities," all of which make for light summer reading. But, sandwiched in we find some interesting features, aspects and pictures of Clark Electrical Pump Controllers, housed in neat vault type cabinets of silver grey with red and chrome trim. And, then, the newest thing pictured is the trim Dead-Front Steel Panel Board for sewage disposal plants, through which several automatic functions start and finish. If you are not on Clark's mailing list for "The Contactor" you are missing something. The address is The Clark Controller Co., 1146 East 152nd Street, Cleveland, Ohio.

"Pipe Selection—What Size; What Material?" are questions answered in a useful guide and handbook from Bridgeport Brass Co., its context having been revised and added to for the new 1939 edition. Judging from its number of reprintings, this little book has apparently proved of worth to architects, engineers and operators. Amongst material contained is the following: "Rules (and tables) for Determining Sizes of Supply Pipe; Risers and Branches", for number of fixtures served; "Minimum Pressures for Satisfactory Supply Through Various Diameter Pipes of Various Materials"; "Proper Size of Service Lines and Meters for Apartment Houses"; "Capacity-Head Loss Tables for Copper and Copper Alloy Pipes and Tubing"; "Definitions of Various Copper Alloy Pipes and Tubes —Weights and Wall Thickness-Specifications". One of the most useful chapters answers the question "Which Brass Alloy Should Be Used?"—(under conditions and for services noted); another cites "Good Piping Practices", followed by "Suggestions for Handling and Economic Working of Copper Tubing", in renewals of house piping and services, and various other installations. For a copy of this useful little 52-page handbook captioned "Water Pipe Sizes"—(1939 Edition)—write Bridgeport Brass Co., Bridgeport, Conn.

"A. A. News Steps Out"—Fresh from the press comes the August number of *Activated Alum News* in its new form—the first illustrated printed issue, of which we hear more are to follow instead of the much less dressy but meaty mimeographed production of the past. The August issue features the traveling laboratory and the research laboratory at Activated's Baltimore Works. It tells of the dustless Black Alum —an improvement over the earlier form of the activated carbon impregnated alum, which did sometimes alter the complexion of those who must fill hoppers. Notes in earlier issues on "How the other fellow does it" are conspicuous by their absence, which we understand is not to be so in future issues. To receive pithy "A. A. News" monthly, write Activated Alum Corp., Curtis Bay, Baltimore, Md.

"LIMITORQUE Valve Control" is described in a bulletin from the Limitorque Division of Philadelphia Gear Works, as that automatic valve operating and control mechanism the heart of which is the patented Torque Limit Switch mechanism. This unit provides positive operation but prevents jamming or damage to valves, because it absolutely limits the torque that may be applied. The control unit is adaptable to all types and makes of valves, with operation effected by manual push-button or automatic control. The illustrations show some forms of valve damage preventable with Limitorque's sensitive but positive control. Reproduced photographs of important installations in fire pumping stations, power stations, on main gates of the newest sewage and water plants, and similar important applications,

are presented to indicate the dependability of the control. For copies of "Limitorque Control" write Philadelphia Gear Works, "G" St. and Erie Ave., Philadelphia.

"A Golden Anniversary" is the theme of the August number of Chicago Bridge and Iron's *Water Tower* which proves to be an extraordinarily interesting issue with its cover of gold and, on the inside, much of historical interest about the company since its founding August 8th, 1889, by a pioneering engineer, Horace E. Horton. From his picture we would say that he was one of the truly rugged pioneers who built bridges to the West long before the company ever thought much about steel water tanks in 1894. It was that year when collegiate son George (now president and chief engineer) persuaded the "old man" that there was money to be made in steel tanks—i.e., if the bottom could be made hemispherical.* (Secret: second tank erected by Chicago Bridge was a wood-stave one, but the tower was steel.) Starting with the one Chicago shop, the company, which has always been owned by the Hortons, has prospered and grown into plants in Birmingham, Greenville, Pa., and Fort Erie, Canada.

(*Ed. Note: The first hemispherical bottom elevated tank was that built for Fort Dodge, Ia. The company lost about $2000 learning how to fabricate the next bottom.)

"EIMCO Vacuum Filters" is a new bulletin in which The Eimco Corporation of Salt Lake City introduces itself to the readers as a firm long established in the mining machinery field, but rather new in the sanitary field with its Continuous Vacuum Filters of both the drum type and the multiple disc type. The bulletin contains an excellent presentation of the principles of the vacuum filter and pictures many installations in the industrial field. The distinctive features of Eimco Filters and Auxiliary Equipment are of interest, as is the list of more than 100 installations. For a copy of this new Vacuum Filter Bulletin No. 402, write The Eimco Corpn., Salt Lake City, Utah.

"Nordstrom Flexible-Coupling Valves"—are described in a new bulletin from the Merco-Nordstrom Valve Co., subsidiary of Pittsburgh Equitable Meter Co. The last improvement in the well known Nordstrom Valve of lubricated plug design (incorporating "Sealdport" lubrication) is the new feature of plain or threaded hub-ends for the purpose of connecting these valves into lines with flexible rubber-gasketed couplings, such as the Dresser or Raybould couplings. Such couplings dampen vibration and eliminate expansion, contraction, and alignment strains. The new style hub-end valves are available in sizes of ¾ inch to 18 inch—the larger sizes being equipped for spur-gear operation. The bulletin presents complete descriptive tables and the prices of each type, which is illustrated in useful dimensional detail. For Bulletin V-129 write Merco-Nordstrom Valve Co., Pittsburgh, Pa., or Oakland, California.

"CLARK General Catalog"—A new complete catalog is being distributed by the H. W. Clark Co. who for 40 years have been serving the water works industry. The 96 page production is replete with illustrated equipment including the very complete line of Clark Meter Boxes; Yokes and Couplings; Valve Casings; Meter Testers; Service and Valve Boxes; Municipal and Special Castings; Copper Pipe and Fittings; Tools and Instruments. For a copy of Catalog "R" write H. W. Clark Co., Mattoon, Ill.

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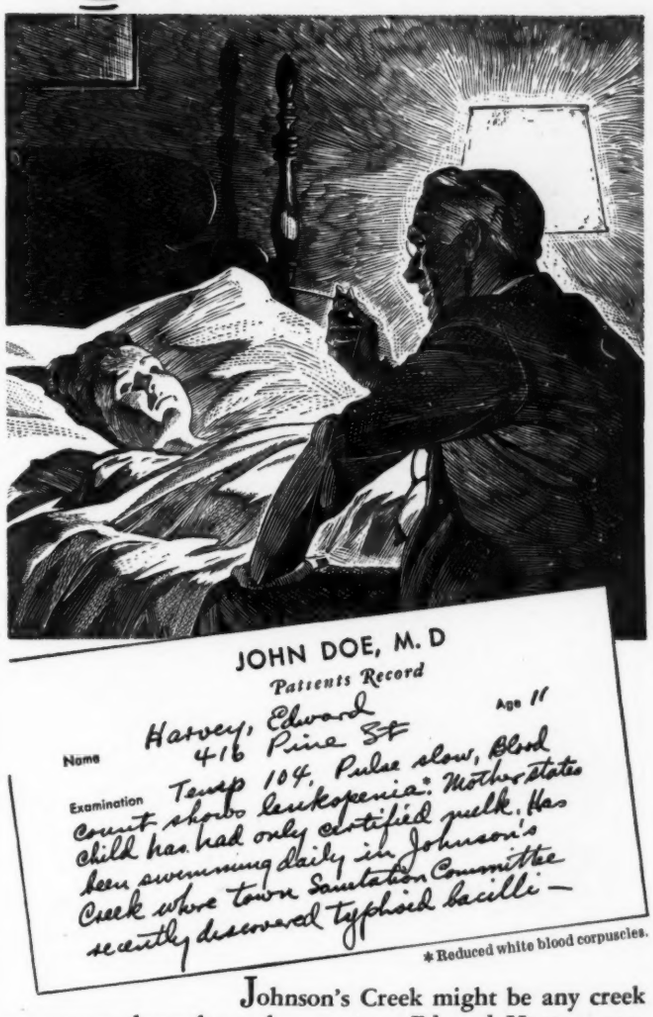
(BUT IT WASN'T SO CLEAN)


JOHN DOE, M. D
Patients Record
Name Harvey, Edward Age 11
416 Pine St
Examination Temp 104, Pulse slow, Blood count shows leukopenia*. Mother states child has had only certified milk. Has been swimming daily in Johnson's Creek where town Sanitation Committee recently discovered typhoid bacilli—
* Reduced white blood corpuscles.

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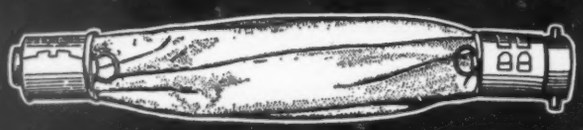

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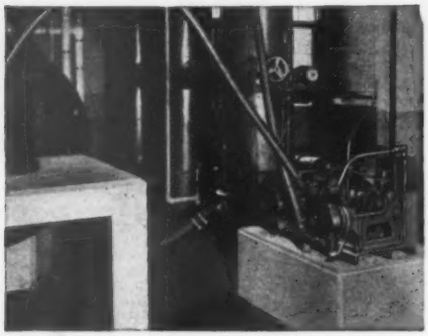

Fig. 1 — RAW SEWAGE CONDITIONING — Two %Proportioneers% Ferr-O-Feeders controlled from variable flow Venturi Meters. 40% Ferric solution is mixed on 2nd floor and drops to large storage tank at rear. Is measured thru the Ferr-O-Feeders into 13 gallon diluter drum with tile mixing baffles, then flows to raw sewage line. These units may also feed Ferrisul or thin line Slurry.

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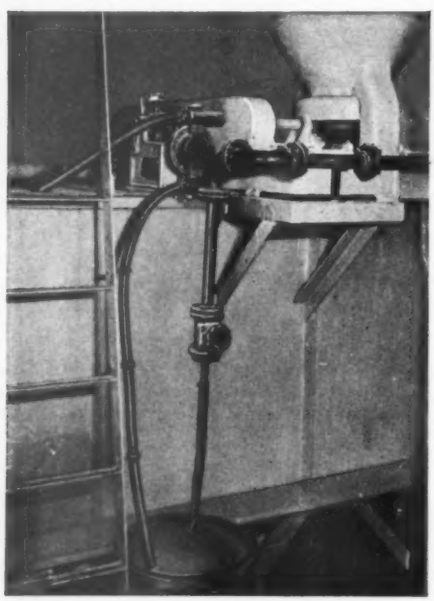

Fig. 2 — SLUDGE DEWATERING — Ferr-O-Feeder driven by chain and sprocket from bucket elevator feeds ferric chloride into sludge for coagulation on vacuum filters.

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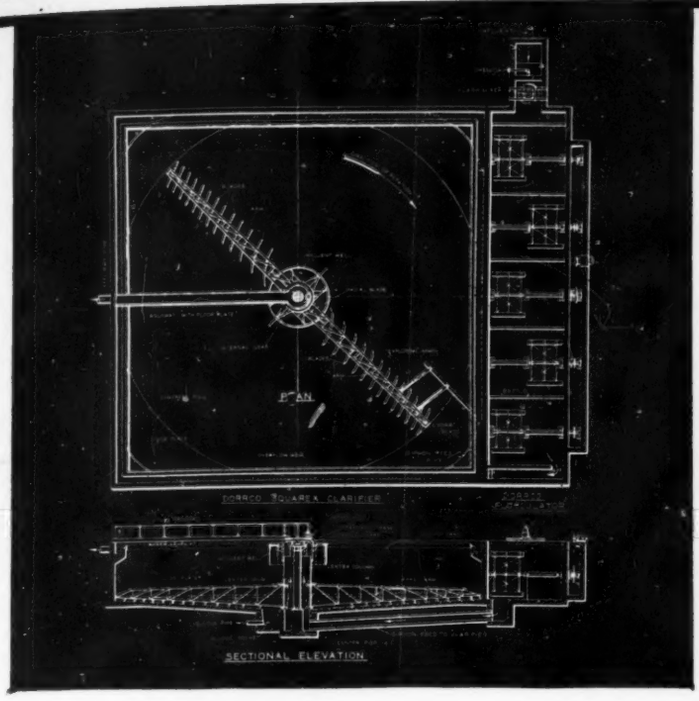
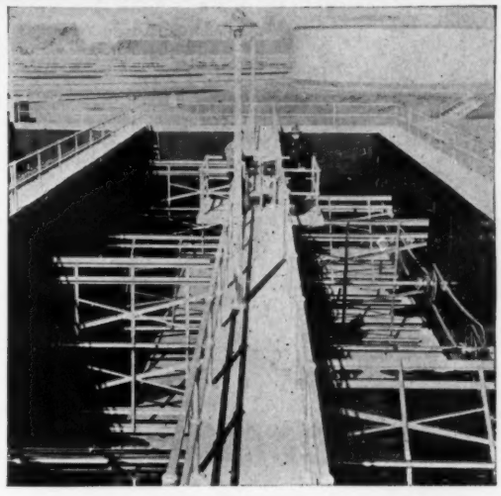
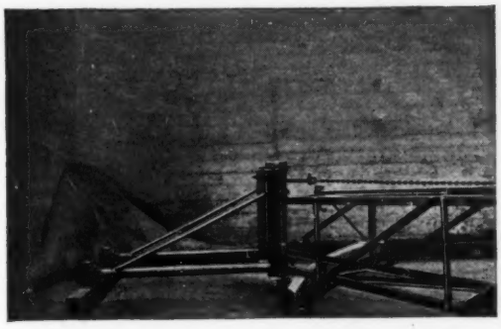
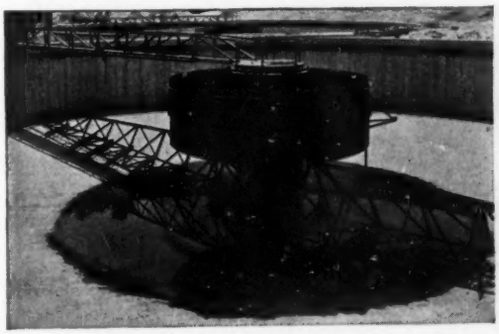




The Flocculation Compartment



The corner Exploring Arm of the Dorr Squarex Clarifier



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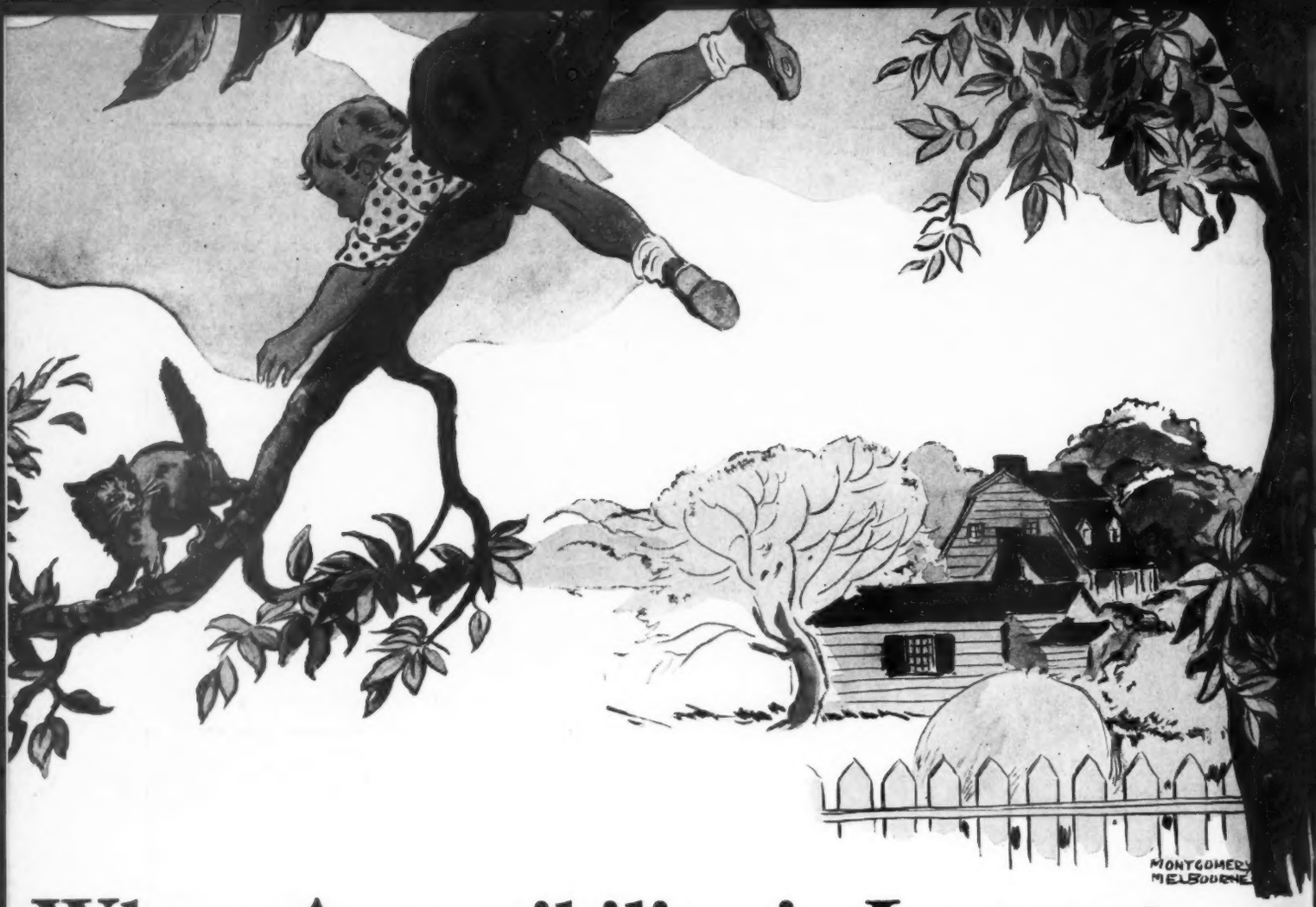
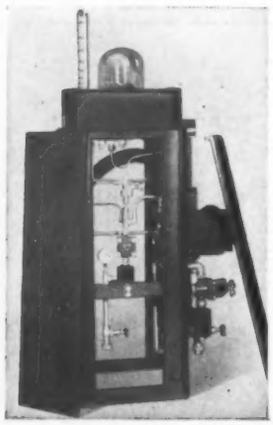


When Accessibility is *Important*..



MAYBE you've never been in the same predicament as our young friend abov but, if you've ever operated a piece of mechanical apparatus, you've doubtle felt just as helpless while trying to make some adjustment or repair.

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